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TWENTY-THREE YEARS OLD.

With the present number THE ELECTRICAL WORLD enters its twenty-fourth year. This represents the whole period during which the electric arts have been developing to their present completeness and perfection. Twenty-three years ago the only practical application of electricity was the telegraph. The telephone was unknown, and would have been regarded as an impossible achievement. The electric light was merely a curiosity of the laboratory. The electric motor was known as a toy, and the dynamo was still a crude experiment. The modern trolley had not even been dreamed of. Through all these teeming years of progress THE ELECTRICAL WORLD has chronicled the advance of electricity, the value and importance of the paper growing in proportion to the enlargement of its sphere. To-day it follows its usual anniversary custom, and presents to its readers a more than ordinarily full and interesting collection of news and special articles.

WATER POWER ELECTRIC PLANTS.

In other columns of this issue will be found a very instructive article by Mr. B. C. Washington, Jr., the second instalment of the one published in THE ELECTRICAL WORLD one year ago, on "Water Power Electric Plants in the United States." The table accompanying the present article completes, as far as obtainable, the list of water powers in the United States now being utilized in the production of electrical energy, making a total of about 220 plants, having a combined output of more than 60,000 horse-power. Some thirty-eight plants are now operating electric street railways, having an aggregate mileage of more than 165 miles. Some 6,000 arcs and 200,000 incandescent lamps are operated by the water-power plants alone. Of the 220 plants enumerated, there are about 50 per cent. having additional steam plants installed for various purposes, such as to tide over heavy-load periods or to meet the emergency of failure of the hydraulic plant, due to either a breakdown or an insufficiency of water supply. Variation in water flow is one of the greatest contingencies which the engineer has to meet. Short periods of variation such as may occur throughout twenty-four hours can readily be met, as in the case of the Hartford transmission, by using a storage battery in conjunction with the distribution service. The same advantages obtain in this case as with steam-driven plants. The variations due to seasonal droughts are, however, more difficult to contend with and can only be met by an additional steam plant.

Perhaps the greatest improvement in hydraulic practice within the past few years has been in the methods of governing. Several of the plants referred to in the list published last year were provided with no governing mechanism of any kind, a practice certainly not to be commended, and one which is rapidly disappearing. Water wheel governors are now constructed which act with equal promptness and with a certainty equal to the best of steam governors, so that a regulation within one-half of one per cent. may be maintained, which is equal to that obtainable with the best Corliss engines. This most satisfactory condition has been brought about by the exacting conditions of electric light service, and the results achieved are to be credited to the able hydraulic engineers, who have appreciated the problem set before them.

The development of water powers for electric purposes promises to increase at a rapid rate, not only for local distribution but for the transmission of power to long distances. In view of the present

enterprises which are now under way, and the better business condition which must before long make its appearance, thus furnishing more ready capital for the improvement of undeveloped water powers, it is quite probable that before the close of the present century the transmission of electrical energy over distances exceeding 100 miles will be an accomplished fact. Mr. Washington calls attention to the splendid opportunities which are offered in this direction.

ELECTRIC RAILWAY CONDUITS.

In the earlier days of electric railways the conduit seemed to exert a peculiar fascination upon inventors. Although almost contemporaneous with the trolley in invention, the conduit languished for nearly ten years, a field for all kinds of impracticable suggestions, and an earnestly desired addition to the usual methods of operating street cars. Within the last two years it has become a demonstrated success, and has taken its place as a competitor with other systems. The conditions obtaining in many American cities forbade the use of the overhead trolley, and animal traction being out of the question, practically compelled the introduction of the dangerous and inefficient cable. It is probable that the cable roads in many instances will turn their expensive conduits into electrical subways carrying conductors and feeders. In many ways the conduit finds its field ready and waiting for it. The equipment of three long and important lines in New York City this Summer will probably result in the accumulation of much useful experience, and may bring to light some valuable improvements upon existing satisfactory conditions.

It is interesting to note that the modern type of conduit, having an open slot, fixed rigid conductors, and a sliding contact is substantially the same as the earliest forms proposed. While there have been innumerable patents for all sorts of conduit devices, closed conduits, magnetic contact systems, etc., and a vast amount of ingenuity and thought expended upon this problem, present practice proves that it was from the first simply a question of good engineering to design a successful system.

Now that such systems are in use, with every appearance of permanent success, municipal authorities have the opportunity to insist upon the abolition of the objectionable cable. No system of traction has appeared that can compare with the modern conduit railways in satisfaction to the public and safety to life and property. The dangers of accidental crossing with other wires, shocks and electrolysis of buried pipes are removed at once, while the cost of installation is no higher than that of a cable system.

THE UNIT OF POWER.

It not infrequently happens that reminiscences, personal surroundings, or even the subject of a discourse inspire in a speaker thoughts to which utterance would not be given were more mature deliberation exercised, or was it not considered necessary to say something out of the ordinary. Such perhaps was the case with Mr. Preece when he was recently invited to deliver the "Watt Anniversay Lecture" in Greenock. But aside from paying an especial eulogium to the name of Watt and giving a splendid account of Watt's remarkable achievements, he revived the question of substituting for the present generally accepted unit of power a multiple of the watt, namely, the kilowatt, now universally used in designating the output of dynamo electrical machines. No one can question the incongruity of the term horse-power or its illogical derivation from a modern standpoint, but the horse-power is no more inconsistent than the rest of the present legal standards used throughout the United Kingdom and the United States. As pointed out by Mr. Preece, Watt found in the introduction of the steam engine his only competitor to be the horse, which, under favorable conditions, could lift 22,000 pounds one foot in one minute. For no other reason, apparently, than to place his engine on a better comparative footing, Watt defined the horse-power as 50 per cent. in excess of that which he experimentally determined. This want of agreement, however, with the fundamental source of derivation is a matter of no consequence, as fully exemplified in the present metrical system. What is of importance is to have a consistent and logical system of derived units, such as the metrical system offers, valuable not merely because it is a decimal system, but because of the ease with which one measure may be converted into another.

The disposition of electrical engineers to adhere to the term horse-power is made evident from their present tendency to rate motors in horse-power rather than in kilowatts. Perhaps the fact also that an engine must be somewhat larger than the dynamo which it is designed to drive, and the necessity, therefore, of multiplying the dynamo output by some factor, is sufficient reason for the present custom of converting kilowatts into horse-power. It has been held by Mr. Preece that the term horse-power has no less than six meanings—as commercial, nominal, indicated, actual, brake and electrical—a statement, however, entirely unwarranted, as each is simply a specific term, indicating the character of the test under which a given machine exerts a definite number of foot-pound-seconds. Although we have been earnest advocates for the adoption of the metric system, we do not believe that any material advantage will be gained, or that attempts to legalize its use will be expedited by adopting its several units piecemeal rather than as a whole. The best method to be pursued is that of educating those who are at present even unaware of the existence of the metric system to appreciate the advantages to be derived by its use. The sentiment which Mr. Preece desired to express in his statement, "Nothing can prevent this system, probably a child of Watt, from ultimately becoming universal all over the civilized globe," is one which will be heartily concurred in by those who have studied the conditions as they now exist, and yet after the adoption of the metric system it is questionable, perhaps, whether English and American engineers will not still adhere to the favorite term horse-power as the French have to their "force de cheval."

HIGH VOLTAGE LAMPS.

As will be noticed in our English letter this week, the demand in England for high voltage lamps shows a marked improvement, aided not a little by the fact that several central stations have now refused to take on new customers on any other basis than that of the higher voltage supply. As has been previously pointed out in these columns, the tendency abroad is to use double filament lamps rather than single filaments, which latter is the only type, we believe, manufactured in this country. High voltage single-filament lamps having a life equal to that of the average low voltage lamps, have an efficiency of about four watts per candle. This apparently, according to our correspondent, has been exceeded in the double filament type now in use in England. The announcement recently made by one of the large manufacturing concerns that it also is prepared to furnish high voltage lamps indicates a more extensive demand for these lamps, and with the added competition will result in the production of lamps having a higher efficiency.

The Next Convention of the National Electric Light Association.

We are informed that the Executive Committee of the National Electric Light Association has selected Niagara Falls as the place for the next (20th) convention of that association. The meeting will be held on June 8, 9 and 10 next. It has not yet been decided at which hotel the headquarters will be located, but it will be either the Cataract or the International. This question will be settled later on, as soon as suitable arrangements can be made. No doubt there will be a large attendance at this meeting on account of the convenient location of Niagara Falls, and there is every probability that the supply interests will be largely represented.

On the Measurement of the Insulation Resistance of Continuous Current Three-Wire Systems While at Work.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

In *L'Éclairage Électrique* for February 6, 1897, Vol. X, No. 6, pp. 241-247, M. Maurice Travailleur, Electrical Engineer of the City of Brussels, Belgium, writes an interesting article upon this subject, and discusses two methods of measuring the insulation resistance of three-wire systems while at work. One of these is by M. Edwin Place and the other by ourselves. Both these methods were described in *L'Éclairage Électrique* in its issue of October 3d, 1896, Vol. IX, No. 40, p. 29. This description is taken from our paper in THE ELECTRICAL WORLD of July 25, 1896, Vol. XXVIII, No. 4, p. 95, while that of M. Place appears to have been taken from *L'Electricien* of August 29, 1896, a copy of which we have not seen.

M. Travailleur states that M. Place's method consists in first observing the potential difference between the positive and negative bus-bars, as well as the E. M. Fs. on each side of the system, and second the strength of current which passes through an ammeter placed between the neutral bus and ground. The deductive process for arriving at values of the insulation resistance of the positive, negative and neutral conductors is said to be obtained from these observations, but the steps are not given. M. Travailleur has been unable to verify this deduction and considers it erroneous. We believe that he is right, for we think it may be demonstrated that it is impossible to determine the individual insulation resistances of the three main conductors from these data.

M. Travailleur then considers our own method, and states that while it is theoretically correct it is not, in his judgment, practically applicable, owing to the large error which may be made in the results by a small variation in the insulation resistance of the system during the time that the measurements are being made. He supports this view by statements concerning his trials of the method on the three-wire system of the City of Brussels.

We think that there is no essential difference between the views which M. Travailleur expresses and those which we expressed in our original paper to THE ELECTRICAL WORLD, and we believe that he would have recognized this had he himself read our entire article, instead of the abstract to which he refers and which we assume that he only has read.

We showed that, at the time we wrote, it was known how to measure the joint insulation resistance (or joint leakage conductance) of a three-wire system at work by applying a known leak at one of the bus-bars, and observing the drop in potential thereby produced at that point relatively to the ground. We pointed out that, so far as we were aware, there were no known means for analyzing this total leakage conductance into its positive, neutral and negative components, without the use of complex apparatus, and we believe that this remains true at the present date. We showed, however, that it was possible by suddenly raising the pressure on one side of the system and noting the resulting elevation of potential on the other side to make the analysis required. The greater the sudden change of E. M. F. made in this manner the more sensitive was the test and the more nearly accurate the result to be obtained, but that since in practice such changes of pressure were necessarily limited in range by the necessity of avoiding disturbance in the operation of the lamps, it would probably be necessary to limit these changes of E. M. F. to about five per cent. Moreover, we pointed out that the test was best conducted with the aid of storage batteries at the central station during hours of light load, and that if the leakage on the neutral was great compared with that on the other conductors, the method became practically valueless, but in that event the observations would show that the greater amount was present on the neutral and the leakage of the neutral would then approximate to the total leakage of the system.

The method operates fairly well on three-wire systems which are moderately well insulated, but gives only rough indications when the system to which it is applied has very low insulation.

In the particular case of the three-wire system of Brussels, to which he refers, M. Travailleur has given up the attempt to separate the three component leakages, since the method we described failed to give trustworthy results. He contents himself with determining the maximum leakage of each conductor by the aid of the following formulas:

Employing the notation of our original paper (See Fig. 1).

Let g_p = the leakage conductance of the positive conductor in mhos $= \frac{1}{r_p}$ where r_p is the insulation resistance of this conductor in ohms.

g_o = the leakage conductance of the neutral conductor in mhos $= \frac{1}{r_o}$

g_n = the leakage conductance of the negative conductor in mhos $= \frac{1}{r_n}$

G = the total leakage conductance $= g_p + g_o + g^n$ (mhos.) $= \frac{1}{r}$

e_p = the E.M.F. on the positive side of the system, (volts.)

e_n = the E.M.F. on the negative side of the system, (volts.)

$E = e_p + e_n$ = the total E.M.F. (volts.)

u_p = the potential difference between the positive bus-bar and ground, (volts.)

u_o = the potential difference between the neutral bus-bar and ground, (volts.)

u_n = the poteutial difference between the negative bus-bar and ground, (volts.)

Then M. Travailleur shows that the minimum insulation resistance r_p min. of the positive conductor which is compatible with a given potential difference u_p, E.M.Fs e_p, e_n, and total insulation resistance r, is expressed by $\frac{E\,r}{u_n}$ ohms; or, the maximum leakage conductance g_p max. $= G\frac{u_n}{E}$ mhos. This assumes that there is no leakage on the neutral side, in other words the minimum insulation or maximum leakage of the positive main consistent with a given potential difference, total insulation and total E.M.F. applied, assumes that all the leakage takes place on the positive and negative conductors.

Similarly r_n min. $= \frac{Er}{u_p}$ ohms or g_n max $= \frac{Gu_p}{E}$ mhos.

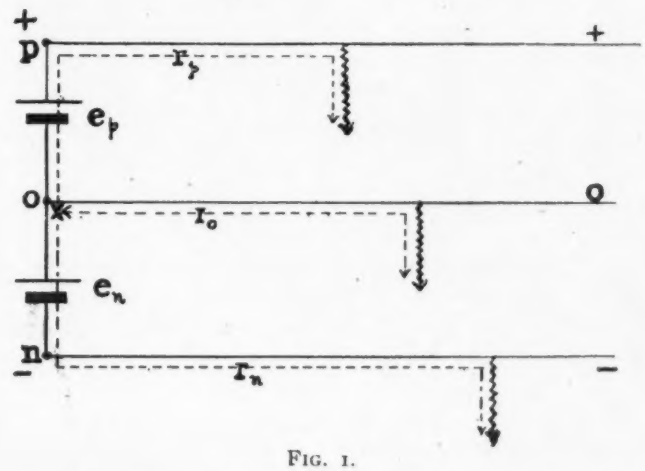


FIG. 1.

Where a similar assumption is made that all the leakage occurs on the positive and negative conductors and none on the neutral.

Again r_o min. $= \frac{e_n r}{u_n}$ ohms, or $\frac{e_p r}{u_p}$ ohms, according as u_p is numerically greater or less than u^n.

Or, g_o max. $= \frac{G u_n}{e_n}$ mhos or $\frac{G u_p}{e_p}$ mhos. This assumes that all the leakage is confined to the neutral conductor and the conductor on which the observation of potential is made.

While these maximum leakage conductances or minimum insulation resistances are very readily observed and calculated yet they are liable in their turn to considerable error; for example, suppose that all three leakage conductances are the same and $= 0.1$ mho so that $G = 0.3$ mho; also $e_p = e_n = 120$ volts. Consequently $u_p = 120$ volts, $u_n = 120$ volts and $u_o = 0$. By the foregoing formulas

g_n max. $= 0.3 \times \frac{120}{240} = 0.15$ or 50 per cent. in excess of the actual value.

g_p max. $= 0.3 \times \frac{120}{240} = 0.15$ or 50 per cent. in excess of the actual value.

g_o max. $= 0.3 \times \frac{120}{120} = 0.3$ or 200 per cent. in excess of the actual value.

Summing up, therefore, we consider that there is no essential difference between M. Travailleur and ourselves. In the particular

three-wire system to which he refers, our formula for analyzing the component leakage conductances is not sufficiently accurate. On the other hand the formula on which he relies for maximum leakage conductance on each main gives a result which must be in excess of the real conductance, and is liable to be considerably in excess. So far as we know, no practical means have yet been found for determining the component leakage conductances by observation of potentials or currents when the total leakage conductance is comparatively large. The method we described is theoretically correct and is fairly reliable in cases where the leakage conductance is not comparatively large.

Electric Lighting at the Inauguration.

With each succeeding inauguration the beauty and brilliancy of the festivities has grown, and the decorative display at the inauguration of President McKinley on Thursday of this week was a fitting successor to those which have preceded it. Every means at the disposal of the decorator was pressed into service on this occasion to enhance the general effect. Not the least among these was the use of electricity to supply certain classes of useful and ornamental illumination to a degree which marks a considerable advance upon earlier occasions.

The conduct of all the local festivities, and, indeed, of everything connected with an inauguration, save the official ceremonies, is placed in the hands of a committee, who arrange the display which attracts the multitude and honors the incoming administration. The expense of the whole is generally more than met by the receipts from the inaugural ball. The decoration and illumination of the great court of the Pension Building, in which the ball was held, were peculiarly beautiful and worthy of the throng which enjoyed them, although neither presented any functional novelty over the decoration and novelty of other large rooms, save in the magnitude of the place and the harmony of effect, for which great credit is due to the gentlemen supervising the work.

On this occasion the decorators strove to give greatest prominence to the flowers, next to the draperies of white and yellow, and least to the lights, which were thus, for the most part, restricted to the function of giving light, although the skill with which they were disposed added greatly to the effect of the illumination.

It is hard to imagine a more fortunate arrangement of lights than that which Mr. John R. Galloway, a local electrician, designed and successfully carried out. The ceiling of the vast court, naturally divided into three parts by the great columns of the structure, was completely masked by three domes of white and yellow challie, which were studded with 16-cp lamps in ground globes. From these domes the white canopy of drapery fell to the walls above the third tier of galleries, whence it was continued on the side walls to the floor. Over 100,000 yards of challie, white and yellow, were used in draping this room.

Under the three encircling galleries, concealed under the ceiling draperies, were carried the systems of three-wire feeders, of 0000 cable, and under the various draperies were also carefully concealed all of the branch-feeders of a very consistent and excellent system of temporary wiring.

Perhaps the most striking feature of the whole scheme of decorative lighting was the treatment of the coronals of the columns supporting the galleries. At the top of each an electrolier of irregular, outwardly-curving branches of polished brass carried eight 16-cp lights, which, from their great irregularity, give the effect of some decorative growth; while from the coronal proper eight other lamps hung on irregular lengths of white cord, studding the column for part of its length, and transforming its white draperies into a glowing cylinder.

Above these 2368 lamps, and around the third gallery, were placed 75 arc lamps, 50 on the series circuit and the remainder, enclosed arcs of the Helios type, on the incandescent circuits. At the west end of the great room, high up on the galleries, was a large electric American flag, built in wavy lines and studded with 440 eight-cp lamps in appropriate colors, which, extinguished in progressive sections by a motor-driven circuit changer. This gave the effect of the flag flapping in the wind.

Over the south gallery another set piece was erected. On a lamp-studded shield of the national colors, made of satin ribbons, a large eagle perched, holding in his claws a sheaf of lamp-tipped arrows, and in his beak a long streamer, one end of which bore the name, "McKinley," and the other end "Hobart," executed in miniature lamps. At each end was a large wreath of laurel leaves, under which a great gilded horn of plenty emptied flowers upon the heads of the people.

In the centre of the south side of the room and at the east end were erected the music stands for orchestra and band respectively, which constituted perhaps the most effective element in the adornment of the room. It was a free copy of the golden gate of the Transportation Building of the Chicago Fair, covered with yellow cloth, and having the lines of the arches carried out in lamps, which were placed elsewhere on the structure in great abundance.

In the centre of all, the fountain in the court was transformed into a grotto of rock-work and aquatic plants, and submerged in the water and scattered among the plants were hundreds of three cp colored lamps.

It will serve to show the extent of this installation to state that there were employed 4700 three candle-power, 1500 eight candle-power and 2368 sixteen candle-power incandescent lamps, and 75 arc lamps.

Direct current at 220 volts for this building was supplied through an existing conduit of the United States Electric Lighting Company's three-wire system. The same Company also furnished the current for the fifty series arc lamps.

In establishing the underground distributing system for Washington such emergencies as these inauguration ceremonies were provided for, and the large demand for extra illumination was supplied without adding a wire to the existing system. Prominent shops and other buildings along the line of march of the parade used strings of incandescent lamps to add attractiveness to their appearance at night, and many electric signs were in evidence along the busier portions of Pennsylvania Avenue and F Street. The United States Company furnished on this occasion the equivalent of 10,000 sixteen cp lamps in addition to its usual load.

Despite legislative restrictions concerning underground wires, the Potomac Electric Power Company put in place, as a permanent addition to the street lighting of the city, 200 arc lights, mostly in the public parks.

The Bureau of Engraving and Printing had lights at its windows and also an arrangement of colored lights nearly covering its large and tall chimney. Two searchlights were operated from the roof of this building as part of its contribution to the general effect. Their proximity to the Washington Monument added greatly to the effect of the illumination.

A most impressive feature of the display was the employment of searchlights upon prominent points, with which the city was swept at night. Placed on the Washington Loan & Trust Building; on the War, State and Navy Building; on the double towers of the Smithsonian Institution; on the new City Post-Office, and on the Capitol, these lights produced very beautiful effects.

The Treasury building was rendered conspicuous in the special illumination effects, its classic roof lines being outlined with incandescent lamps. On the State Department facade a huge American shield attracted the attention of the multitudes, and from the highest point of the War Department a sixty-foot illuminated flag stood out in electric light against the black sky with beautiful and inspiring effect.

Telegraphy Without Wires.

An article in the March number of *McClure's Magazine* describes the experiments now being conducted in England by Gugliemo Marconi for telegraphing without wires.

At the Liverpool meeting of the British Association, Mr. W. H. Preece called attention to these experiments, which have been conducted since with his collaboration. Mr. Marconi's results are remarkable. He seems to have discovered a new form of electrical wave, somewhat similar to the Hertzian wave, yet differing greatly in its penetrative power. On Salisbury Plain he has succeeded in sending intelligible signals a mile and three-quarters, while during some former tests signals were exchanged between two points separated by a hill three-quarters of a mile thick. It is the belief of the inventor that his new waves will penetrate all substances.

The inventor and Mr. Preece are now working at Penarth, in Wales, to establish regular communication with a lightship some miles at sea. It has been proposed to establish in connection with lighthouses a constant source of electrical waves, which will penetrate the densest fog and make themselves evident on shipboard to proper receivers.

In regard to the use of this system in naval operations, Mr. Marconi speaks of a curious danger to be apprehended from induction sparks, which might explode the magazine of a warship.

Water Power Electric Plants in the United States.—II.

BY BUSHROD C. WASHINGTON, JR.

IN the issue of THE ELECTRICAL WORLD of March 7, 1896, there appeared the first installment of an article on the "Water Power Electric Plants in the United States." At that time I had collected information concerning some of the many plants then in successful operation, and published a list of 124 plants, with a tabulated statement of the methods of obtaining the power and the application of the same for the generation of electricity, and the results obtained. Since then I have continued my investigations, pursuing practically the same methods, and the results obtained are highly satisfactory, since I have succeeded in securing detailed information from more than a hundred other water power electric plants.

Many of these plants were in operation at the time I was busy gathering information and data for the first part of this article, but for reasons unknown to me, their managers failed to comply with my request for data concerning them. Many other plants were then in course of construction, and consequently could not give out any definite information. The results of the recent investigation are given herewith and show almost marvelous progress in the utilization and development of water powers all over the length and breadth of this country. Some of these plants are most noteworthy triumphs of hydraulic and electrical engineering and deserve special mention. The accompanying illustrations are intended to show the many methods employed to obtain the best results under varying conditions.

As previously stated, there is at present a great waste of water power in the United States that can be easily developed and made to pay handsome dividends to those who have the business energy to look them up and improve and develop them. Some of these water powers are not very distant from large business and manufacturing centres, where the power could very easily be delivered and disposed of. In this connection, I will cite the case of the power at Great Falls, on the Potomac River. These falls are only 18 miles distant from Washington City. It has been stated by competent engineers that there is sufficient power there, if properly developed and transmitted to Washington, to operate every mile of its extensive system of street railways, light all its streets and houses, and drive all the machinery of the mills and factories, and have a surplus of power left over that would amply justify its transmission to the City of Baltimore, some 38 miles distant from the Falls.

The problem of electrical transmission for long distances has been successfully solved, as is evidenced by the great plants at Niagara, N. Y., and Folsom, Cal. I do not think the day is far distant when we shall see large companies organized for the purpose of locating and purchasing all the available water powers of commercial importance, developing the same and transmitting the power by electricity to points where it can successfully, from a business standpoint, drive out its steam competitor. Such a company, acting on the advice of its corps of experienced hydraulic and electrical engineers, could very readily ascertain the locations of the important unimproved water powers and buy them up, after being fully assured that the investment of capital in their purchase and development would yield a good return.

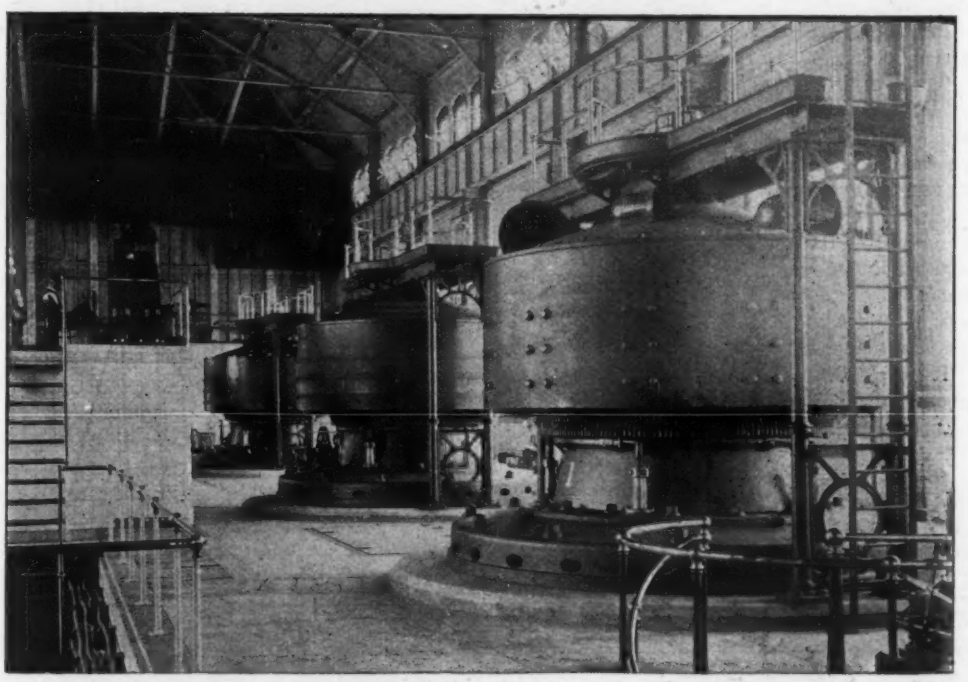


FIG. 2.—5300-HP TWO-PHASE GENERATORS OF THE CATARACT CONSTRUCTION COMPANY.

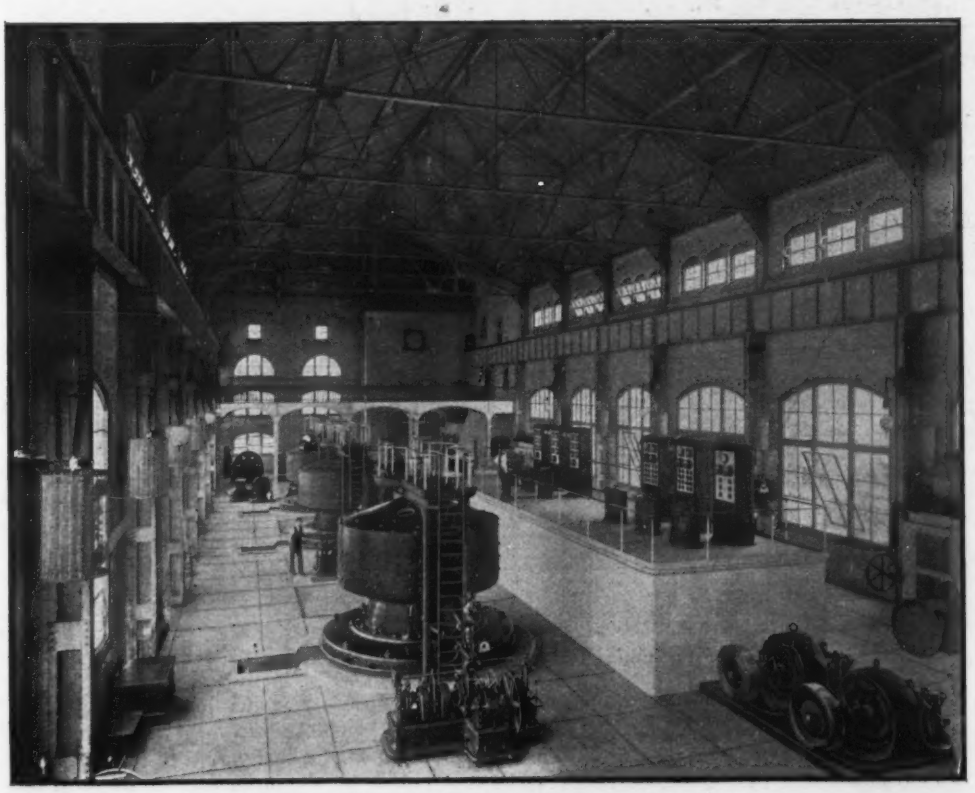


FIG. 1.—POWER HOUSE, CATARACT CONSTRUCTION COMPANY.

It is probable that many of the undeveloped water powers are neglected through the ignorance on the part of their owners of the progress made in the transmission of power by electricity, and their lack of knowledge is due, perhaps, to the fact that there are not very many journals devoted to this subject.

Some powers are but partially developed, only a rough dam having been constructed to create sufficient power to meet the immediate requirements. Many of these powers, by the expenditure of more capital, are susceptible of a great increase in power, and are frequently in localities where its transmission would pay. There are also

many powers fully developed, where the dams are so constructed that the maximum fall is obtained and the entire amount of water is not consumed by the turbines. It is this class of powers that furnishes so many examples of wasted power; wasted power, because it is salable under proper conditions. It may be a case where the power is only used during the daytime, and at night allowed to run over the face of the dam when it could be utilized for lighting a nearby town.

There are also cases where the water powers have been abandoned because the mills or factories were not operated at a profit; already several such cases have come under my immediate observation, and I know they can be improved and the power transmitted and disposed of.

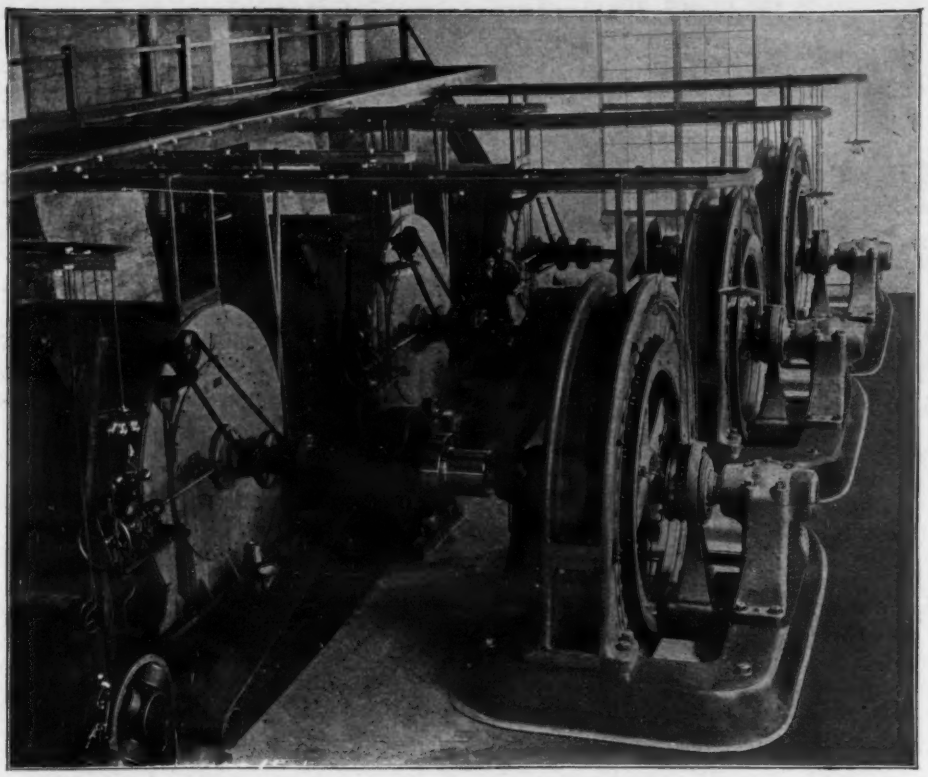


Fig. 3.—Interior of Power House of Pelzer Manufacturing Company at Pelzer.

It may be well in this connection to point out to the owners of good water powers a ready way of determining their value. First ascertain how much power is available during low water season. Then make estimates of the cost of building a durable and suitable dam to get the maximum fall and a good storage reservoir. Also estimate the approximate cost of a suitable and completely equipped power house, the construction of the line for the transmission of power, and also the cost of operating the plant when completed.

Now learn how much of this power the nearest city or town requires for municipal and commercial lighting and for operating its various factories, mills, printing houses, elevators and electric fans, and, in fact, any steam-driven machinery.

Having learned what power is required and that those using steam will discontinue it for electricity, you can compute very nearly the receipts to be expected from the sale of the power, and then determine the advisability of building the plant. If the power is known to be large and reliable, you should in the first place submit the problem to any of the large manufacturers of water power machinery and have their experts pass upon the case. All of them keep an able corps of experts for this very class of cases. If they determine the falls are worth developing you can rest assured they can furnish you with a plant completely equipped in every respect, and up to date in every particular with the progress made in the economical use of water and generation and transmission of electricity.

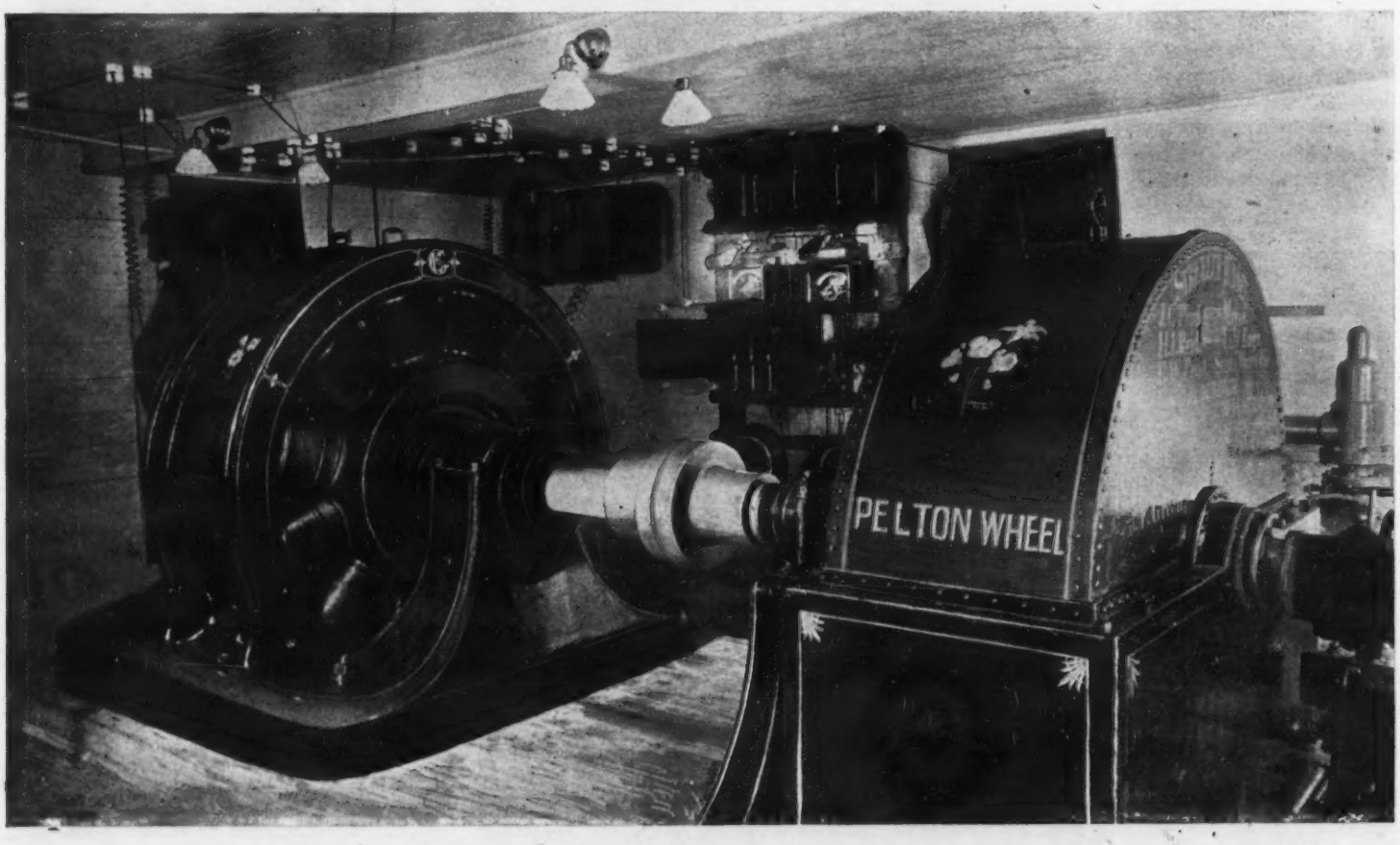


Fig. 4.—The 150 kw Three-Phase Electric Plant at Manitou, Colo.

Should the water power prove insufficient to meet all the requirements, an additional steam plant can be easily added. It would be well to have a reserve steam plant for the protection of patrons, for there is always a possibility of accidents, no matter how carefully

they are guarded against. Low water and floods may lessen the required efficiency of the plant, and then a steam reserve becomes a matter of necessity.

While my statistics regarding water power electric plants are confined to those plants in the United States, it does not follow that we are alone in building such plants, for there are a great many other installations of similar plants in other parts of the civilized world. Some of these are quite important, and great difficulties were encountered in their construction, as well as in the matter of transporting the necessary machinery for the works.

The tabulated statement of the water power electric plants is practically on the same lines as that in the first part of this article, already published.

Again we observe an enormous amount of horse-power developed and used for all the purposes requiring power for driving machinery, railway lines, and electric lighting. In mining districts we find the power is carried for long distances and used in operating the stamp mills, hoisting machinery, air compressors, and for lighting the interiors of the mines ; and in manufacturing localities, operating cotton mills, etc.

Omitting plants having additional steam-power, and summing up the results obtained by water-power plants alone, we have as follows: Over 2700 arc lamps, 81,000 incandescent lamps, 5000 horse-power of motors and 83 miles of electric railway, operating 65 motor cars and trailers.

The above figures could be very materially increased should I add to them the work done by plants that have additional steam power for emergency only, and only in use a part of the year, or for a few hours during the night when the load on the generators is very heavy. Besides the many uses the water is made to serve after its power has been converted into electricity, I may add that there are several cases in the western part of the United States where it is afterward used for irrigation purposes.

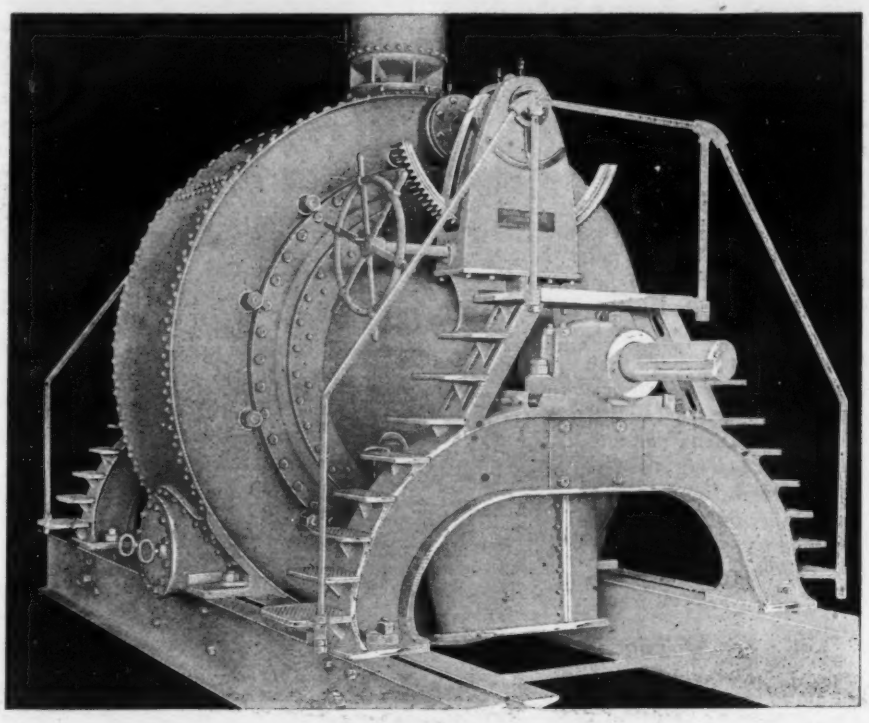


FIG. 5.—ONE OF FOUR 2000-HP TURBINES OF THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY.

Figs. 1 and 2 show the interior of the power house of the Cataract Construction Company, at Niagara Falls, N. Y.

It is useless to attempt to give details concerning this great plant, for this has been donealready by the engineers engaged in its construction.

All the machinery for this mammoth power plant is of special design and construction. The 5000-hp turbines were designed by Faesch & Piccard, Geneva, Switzerland, and were built at Philadelphia, Pa., by the I. P. Morris Company.

The generators were built by the Westinghouse Electric & Manufacturing Company. They require about 5150 horse-power delivered through the turbine shaft and deliver 5000 electrical horse-power each. In meeting the required conditions the manufacturers of the water wheels and generators—and indeed all the machinery used in this plant—have attained the highest perfection in design and construction of hydraulic and electrical machinery by utilizing the most advanced ideas known in modern engineering—ideas that are the product of evolution in brain work and infinitesimal accretions to the fund of human knowledge.

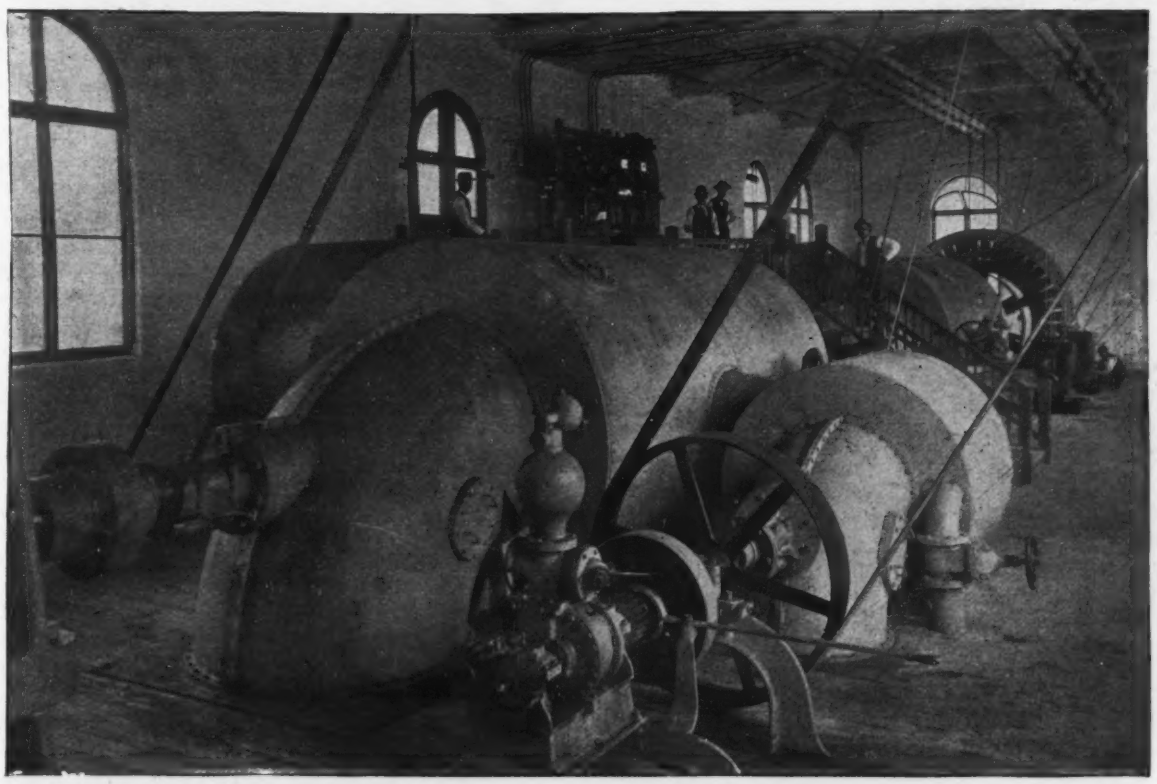


FIG. 6.—INTERIOR GENERATING STATION, COLUMBIA MILLS COMPANY, COLUMBIA, S. C.

Fig. 4 shows the water-wheel and generator, electric plant at Manitou, Colo.

This plant consists of a 500-hp Pelton water wheel direct-connected to a 12-pole 150-kw three-phase, 3600-volt General Electric Company's generator, running at 600 revolutions per minute. The power thus generated is transmitted a distance of eight miles, supplying through step-down transformers a 75-hp three-phase induction motor running an air compresser for operating air drills in the Strickler Tunnel. This tunnel is 6400 feet long, and forms a part of the water-works system of Colorado Springs. The tunnel is being driven from both ends, and light and power is supplied from the power station for the power house and the underground work. It is part of the plans of the water-works company to use water from the reservoir for operating Pelton water-wheels and generators for lighting the city of Colorado Springs.

Fig. 6 shows the interior of the generating station of the Columbia Mills Company, of Columbia, S. C. Two pairs of 48-inch Victor turbines, made by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., operated under 26-- feet head of water, develop 2000 horse-power. One 24 inch wheel under same head develops 190 horse-power, making a total of 2190 horse-power. This power drives two 500-kw three-phase alternators, direct connected to the turbines, running at a speed of 108 revolutions per minute. The power is transmitted a distance of one eighth of a mile to the cotton mills and there drives 17 75-hp inverted electric motors, and these operate the machinery of the cotton mill. This plant was begun in the Spring of 1894, "and is a fine example of the advantages and economies to be obtained by an electric system of power distribution, even where the distance of transmission is small."

Fig. 3 shows the interior of the power house of the Pelzer Manufacturing Company, at Pelzer, S. C. This company is one of the largest manufacturers of cotton goods in the South. The transmission plant consists of three pairs of 60-inch turbines, made by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., direct connected to three 750-kw three-phase generators, wound for 3300 volts. The turbines are run under 40 feet head of water, 164 revolutions per minute. The power is carried three miles to the mills. The motors consist of one 400-hp synchronous motor, wound for high potential; fifteen 110-hp, four 75-hp, two 50-hp, one 20 hp, and four 5-hp. "Most of these motors are of the inverted type, and are suspended from the ceiling, and receive current at low potential from step-down transformers, located in the sub-station at the mills." The mills are lighted by 1200 incandescent lamps, from the same power.

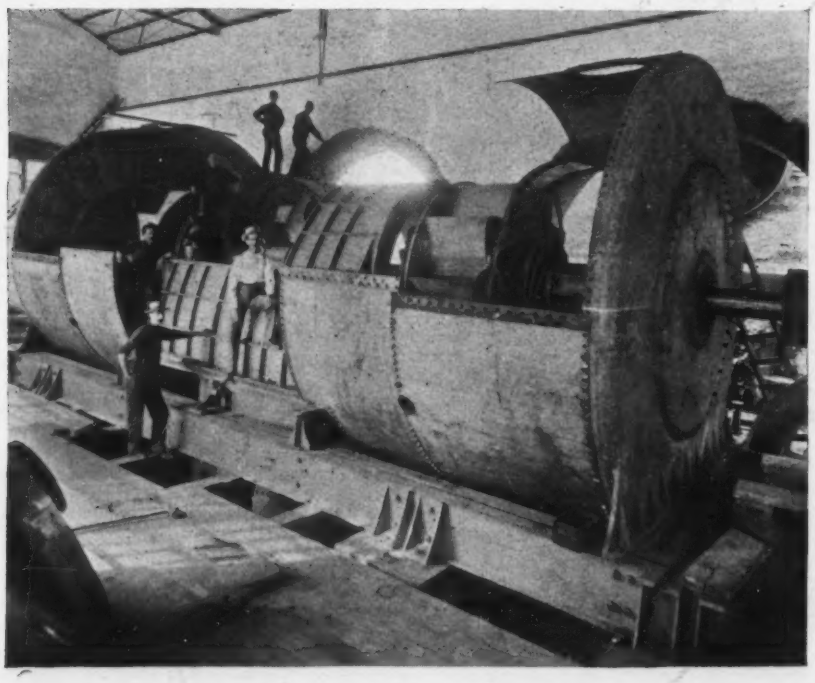


Fig. 8.—Setting up Turbines Shown in Fig. 7.

Fig. 5 shows one of the four turbines constructed by James Leffel & Co., of Springfield, O., for the Niagara Falls Hydraulic Power & Manufacturing Company. These turbines were constructed especially for the above-mentioned company, and are known as James Leffel & Co.'s Niagara type, and weigh about 50 tons each, and are mounted on heavy, double steel beams, placed upon solid stone foundations. These beams span the tail-race. The turbines operate under 210 feet head of water, and develop 2000 horse-power each. They are so constructed that any one of them can be operated or shut off at will. On each end of the shaft of three of the turbines are connected by flexible couplings two 560-kw generators, made by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. These generators are run at 250 revolutions per minute, and generate 2000 amperes at 280 volts.

The fourth turbine runs at 300 revolutions per minute, driving

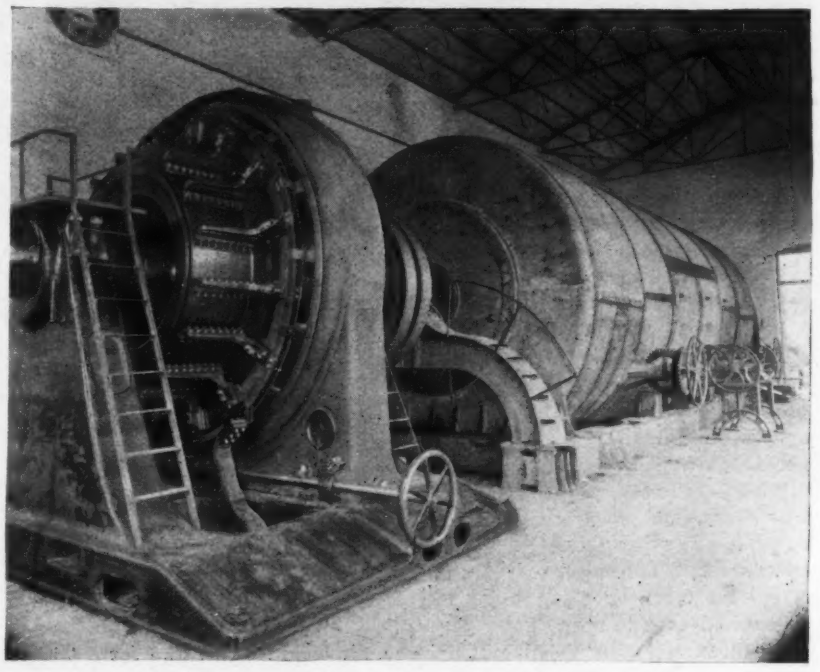


Fig. 7.—Interior of Power House, Boston & Montana Consolidated Copper & Silver Mining Co.

two generators built by the General Electric Company, the capacity of these generators being 1000 amperes at 550 volts. One wheel is driving two trolley railroads. This wheel is governed within 2 per cent. of a uniform speed by a Lombard water-wheel governor, built by the Lombard Water-Wheel Governor Company, of Boston.

This governor shown in Fig. 9, is the Lombard Company's type G, and was made specially for use in connection with the Leffel turbine water-wheels in the plant of the Niagara Falls Hydraulic Power & Manufacturing Company.

The problem of governing these turbines was regarded as a very difficult one on account of the great head under which they operate and also for the reason that it was necessary that the speed regulation should be very close under any working conditions, and give perfect safety from excessive speed in case of the whole load going suddenly off, as in the case of circuits opening. It was also necessary that the working speed should be the same when the turbines were working at practically no load and when they were fully loaded.

As will be seen from the illustration, the governor is set in operation by variations in the centrifugal force of four rotating balls, which travel normally at the rate of 1000 feet per minute. These balls are suspended on laminar steel springs of unusual length and sensitiveness. Very small variations in the speed cause considerable changes in the radial position of the balls, and the valve operated by them responds to speed variations, which would not be felt by any other governor.

Unlike the previous types of the Lombard governor the valve connected with the centrifugal balls does not deliver fluid under pressure directly to the cylinder operating the gates, but on the contrary it delivers it to a small cylinder (the uppermost of the three) the sole function of which is to move the main valve of the governor. As the valve and port areas of this small cylinder are very large in proportion to its area, the motion of the piston contained therein is very prompt. As this small piston exerts a thrust of about

1000 pounds against either side of the main valve it is evident that the size of the main valve may be great enough to give a very prompt gate action, without throwing any appreciable work on the centrifugal balls.

The main piston delivers a thrust of 8500 pounds on the rack which is geared directly to the quadrant on the gate stem. The fluid medium in this governor is water under flume pressure, and the exhaust works against atmospheric pressure, and not into a vacuum as in other types of the Lombard governor. This governor also has devices for preventing racing and giving a constant working speed irrespective of load.

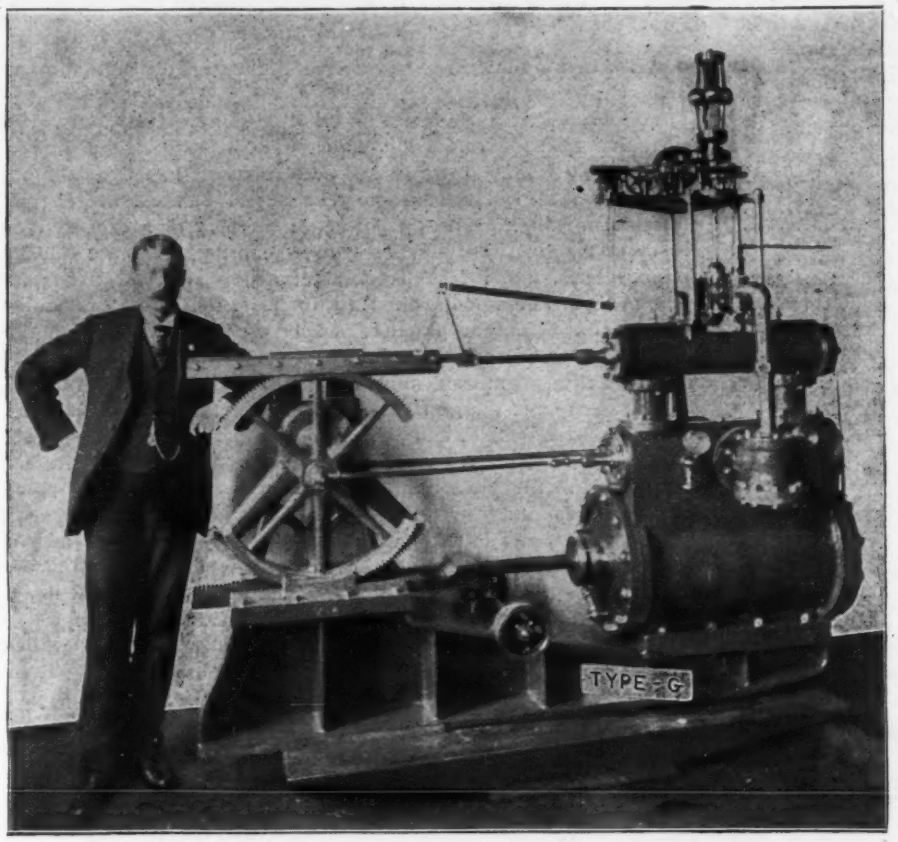


FIG. 9.—LOMBARD WATER-WHEEL GOVERNOR.

The Dayton Globe Iron Works Company, of Dayton, O., recently finished the construction and erection for the Boston & Montana Consolidated Copper & Silver Mining Company, of Great Falls, Mon., of what is probably the largest and most powerful pair of horizontal turbines for the head of water under which they operate that have ever been built by any turbine manufacturers in the world.

These turbines, as shown in Figs. 7 and 8, are of the new American patterns of the latest design, 57 inches in diameter, and under the head of 50 feet will develop 3945 horse-power.

The turbines are placed in a cast-iron draft tube 10 feet in diameter, and are incased in an iron flume 14 feet 4 inches in diameter, 32 feet 6 inches long, made of ½-inch tank steel, with cast-iron heads, and the flume is mounted on two pairs of double-I beams, 20 inches deep, 38 feet long.

The shaft in the wheels is 10 inches in diameter, 42 feet 2 inches long, made in two sections, and its weight is over five tons. The clamp-coupling which connects these two sections of shafting in the centre of the draft-chest weighs considerably more than one ton. There are stands weighing four tons each, outside of flume at each end, which carry the journal-boxes for this shaft.

The two turbines, with their complete outfits, as shown in Fig. 7, weigh approximately 250,000 pounds, and their design and construction reflect great credit upon the engineering skill of the Dayton Globe Iron Works Company, and are also an excellent example of their ability to construct this class of machinery on a mammoth scale.

These turbines are to operate two Westinghouse electrc generators, one coupled directly to each end of the shaft, which runs from 144 to 160 revolutions per minute, and will be used for electric refining. The varying revolutions are required in order to increase or diminish the current as conditions may require.

The power of these wheels is also utilized for driving an arc light dynamo and the two 50-hp exciters for the large generators, the power being transmitted from wheel shaft to dynamo by means of a 20-inch double leather belt, and there still remains a surplus power in the wheels, which is not being utilized at present.

Fig. 10 shows the interior of the power and transmission plant of the Wanoosnoc Power Company, Fitchburg, Mass. Six 28-inch Pelton wheels, two in a case and all on one horizontal shaft, are used for driving the dynamo, a 400-hp two-phase Westinghouse machine. The water-wheels operate under 130 feet head. The current is transmitted 2½ miles to the machine shops and saw-grinding works and operates 347½ horse-power of electric motors.

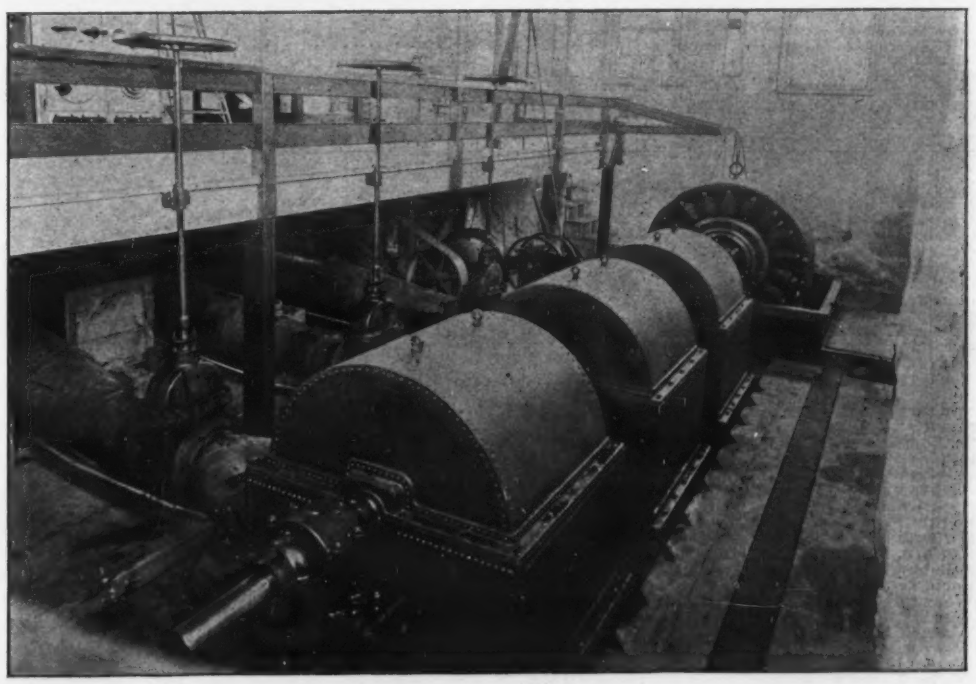


FIG. 10.—THE 400-HP TWO-PHASE PLANT OF THE WANOOSNOC POWER CO., FITCHBURG, MASS.

Report of Massachusetts Gas and Electric Light Commissioners.

The 12th annual report of the Board of Gas and Electric Light Commissioners of Massachusetts has just appeared. It is especially full of data concerning municipal plants, of which there are now thirteen in the State. Perhaps the most interesting part of the report concerns accidents and fatalities due to gas and electricity. It appears that during the year 1896 there were no less than 51 persons killed and 118 injured by escaping gas, while during the same period only five met their death from electricity, and only twelve were injured. Of the five who were killed, three were employees of electric light companies and one was killed while trespassing upon a fire escape outside of Music Hall, in Boston. About the same proportion holds among those who were injured. It thus seems that during the year only one person in the pursuit of his business was killed by electricity in Massachusetts, while gas scores 51 victims.

Water-Power Electric Plants Not Mentioned in the Table Published in "The Electrical World," March 7, 1896.

LOCATION OF PLANT.	Head of water in feet.	Dynamos direct-connected.	Dynamos belted.	Additional steam plant.	Number of arc lamps.	Number of incandescent lamps.	H. P. of motors.	No. miles electric R. R.	Number of cars operated.
Aiken, S. C.	45		x	x	35	2600			
Alpena, Mich.	10		x		100	1300			
Auburn, Cal.	57		x			1000			
Ansley, Neb.	18		x			500			
Arkansas City, Kan.	22		x		105	750			
Ashland, Neb.	16		x			700			
Antrim, N. H.	14		x			1700			
Battle Creek, Mich.	11		x		100	1200		8	8
Beloit, Kan.	9		x	x	27	540			
Brandon, Vt.	61		x	x	30	1000			
Baxter Springs, Kan.	8		x		1	350			
Burlington, Wis.	10		x	x	12	1600			
Bangor, Pa.	46		x	x	52	900			
Bodie, Cal.	344		x			200			
Brodhead, Wis.	10		x			400			
Buena Vista, Col.	20		x	x		600			
Bondville, Mass.	22			x		1500	225		
Belton, Tex.	15		x	x	20	1400			
Constantine, Mich.	7		x			350			
Chateaugay, N. Y.	11		x			400			
Cedar Falls, Ia.	9		x		3	300			
Concordia, Kan.	8		x	x	52				
Columbus, Ga.	9		x	x	325	6000	200	48	30
Canandaigua, N. Y.	24		x	x	185	2000		3	7
Dayton, O.	9		x	x	300				
Downieville, Cal.	300		x			110	120		
Dowagiac, Mich.	11		x			1200			
Earleville, N. Y.	8		x	x		1000			
Eaton Rapids, Mich.	10		x	x	35				
East Pasadena, Cal.	115		x			1200			
Echo Mountain, Cal.	V't	x	x	x	6	500	190	7	5
Fulton, N. Y.	15		x		105	2300			
Folsom, Cal.	55		x		475	5000	325	22	22
Fitchburg, Mass.	130	x		x			347		
Fair Haven, Vt.	120		x	x	20	125			
Fresno, Cal.	1410	x		x	150	4500	400	9	4
Fairfield, Me.	12		x		160	2500	25		
Gem, Idaho.	90		x			500			
Greenville, Mich.	12		x	x	40	600			
Gonzales, Tex.	7		x	x		600			
Gladwin, Mich.	11		x		4	500			
Gothenburg, Neb.	45		x		21				
Ithaca, N. Y.	94			x	120	5000		7	14
Junction City, Kan.	10	x			40	600			
Kennebunk, Me.	11						200		
Keene, N. H.	16		x	x	100				
Lockport, N. Y.	35		x				300		
Lyons, N. Y.	9		x	x	64	700			
Leicester, Mass.	18		x	x		2000			
Lockport, Ill.	16		x		10	500			
Lewiston, Me.	28		x		200	1500	90		
Lampasas, Tex.	16		x			1100			
Milford, N. H.	18		x	x		1400			
Mauch Chunk, Pa.	24		x		40	4000	100		
Mauch Chuuk, Pa.	12		x				200	4	6
Mishawaka, Ind.	8		x	x	85	1800			
McMinnville, Tenn.	11		x		25	10			
Minneapolis, Minn.	45		x	x	1800	50,000			
Monticello, Ia.	7		x	x	14	2000			
Mt. Morris, N. Y.	15		x	x	40	800			
Meredith, N. H.	38		x		10	280			
Manitou, Col.	600	x					500		
Neenah, Wis.	8		x	x	120	2000			
North Billerica, Mass.	10		x	x	2	1027	24		
New Castle, Cal.	464	x			170	700			
New Berlin, N. Y.	13		x		1	1000			
Oroville, Cal.	120		x			700	100		
Ogdensburg, N. Y.	10	x					25	10	7
Oxford, N. Y.	27		x	x	30	950			
Ottawa, Ill.	31		x	x	317	2747			
Orange, Mass.	15		x	x	48	2000			
Oconto Falls, Wis.	40		x			400			
Petersburg, Va.	10		x	x	200	2000	50		
Pelzer, S. C.	40	x				1200	2500		
Petoskey, Mich.	10		x	x	56	1900			
Pawtucket, R. I.	17		x	x	*	*	*	*	*
Rockford, Ill.	7		x	x	*	*	*	*	*
Spokane, Wash.	70		x		500	13,000		33	14
Silverton, Col.	180		x	x			325		
Superior, Neb.	17		x		18	450			
St. Louis, Mich.	12		x	x	10	900			
San Marcos, Tex.	12		x			2000			
Salt Lake City, Utah.	380	x			480	20,000			
Santa Cruz, Cal.	923	x			10	2500		6	8
Spearfish, S. D.	20		x	x	12	1100			
Seguin, Tex.	7		x			550			
Springfield, Mass.	35		x	x	700	10,000	400		
Sanford, Me.	14		x	x		40		3	
Salisbury, Md.	9		x			1000			
Somerset, Pa.	13		x	x		300			
Woonsocket, R. I.	16		x	x	233	8275	800	16	20
Ward, Col.	740	x				50	10		
Wallace, Idaho.	320		x		50	1200			
Weaverville, Cal.	260		x			800			
Westbrook, Me.	12		x		40	4000			
Walla Walla, Wash.	75		x		60	600			
Wilmington, Ill.	11		x	x	2	500			
Watsonville, Cal.	220		x	x	20	2000			

* These left out in statements furnished by engineers in charge of plants.

A Late Beginning.

According to an Austrian journal, the first electric railway in Vienna is now to be put in operation.

The Development of Water-Powers in the United States.

In response to a circular letter sent to several of the most prominent water-wheel manufacturers of the United States and Canada, requesting their opinions regarding the development of water-powers in this country for the long-distance transmission of electrical energy, The Electrical World has received the following replies:

Mr. W. C. Parsons, Secretary of the Replogle Governor Works, Akron, O., writes:

"We cannot speak as experts on this question, and can only give the results of our observation in connection with those water-power plants, the governing of which has been intrusted to us.

"Perhaps the most remarkable case is that of the San Joaquin Electric Company, furnishing power for the City of Fresno thirty-five miles distant from its water-power plant, where three 500 hp Pelton wheels, under 1410 feet head, are doing most satisfactory work, the speed being controlled within closer limits than shown by the best Corliss engine practice. Other well-known plants might be named, as at Folsom, Cal., the power being transmitted to Sacramento, twenty-two miles distant; the plant of The Portland General Electric Company, Oregon City, Ore., is transmitting power fourteen miles to Portland, and very satisfactory results are being attained in each case. The successes so far seem to demonstrate beyond question the practicability of such enterprises from a commercial standpoint.

"It is quite possible that perfection has not yet been reached in the matter of transmission of electrical power for long distances; but doubtless the electricians are equal to the task, and will make improvements which will overcome all defects.

"The problem that we are most interested in is that of the government of the water-power plant, and it is a most essential one to the success of such enterprises. Too little attention has been paid by the hydraulic engineers in the past to the question of government of water-wheels. There are numerous cases where unnecessary expense has been incurred in bringing water through long closed horizontal flumes to the detriment of the government of the wheels. The demand to-day is often for the instantaneous change of load from zero to three-fourths or perhaps the full power of the wheel, and in such a case the confinement of the water supply in the long closed flume is fatal to successful governing on account of the inertia of the water, which must be overcome before gravity effects can be had on the wheel.

"Another most important matter which is often overlooked is the fly-wheel or power-storage capacity of the plant. No one would think of attempting to run a steam-engine of 1000 horse-power, even with a direct-connected generator, without providing a heavy fly-wheel to steady the speed and carry the load where sudden changes are required. This stored energy that we find in the fly-wheel of the steam-engine is just as essential in the government of the water-wheel as in the government of the steam-engine, nay, more essential, for the reason that the steam with its expansive quality will supply power to the piston of the engine far more quickly than inelastic water can be put in motion even if it is in abundant supply immediately over the wheel, not to speak of the cases above referred to, where the water supply comes through long closed horizontal flumes.

"We are aware that there are those who claim to disregard the principles involved in these suggestions, but we believe that the principles stated are correct, and will meet with the approval of every thoughtful engineer, and surely, with the extreme demands for close regulation that the use of water-power for electrical purposes has brought in, it behooves every hydraulic engineer when making plans for such a plant to do his utmost to avoid the conditions that are fatal to successful government."

Messrs. Barber & Watson, Meaford, Ont., write:

"We are pleased to say that the subject is one of very great interest to us, as we believe it will exert a great influence on the future development of Canada. The central provinces of Canada have no coal fields, so that fuel is an expensive item. On the other hand, water-powers abound in these provinces; some are situated so that the direct driving of machinery is both possible and practicable; others are so situated that it would be impossible to construct large factories to be driven directly, and it is in this latter case that electricity steps in and overcomes the difficulties. This is precisely what is being done in Canada to-day; water-powers that were formerly inaccessible are being used to generate electricity, which is then transmitted to some suitable site, where the factory is built.

While this is going on in our older provinces, the mineral resources of the Province of British Columbia are being rapidly developed, and we expect to see electricity generated by the many falls afforded by the mountains and used in the reduction of ores. The outlook for electrical engineers and water-wheel manufacturers is a bright one at present, but the latter must stir himself and get out of the old ways if he is to meet the requirements of the present and coming days."

Mr. William Kennedy, Jr., vice-president of the William Kennedy & Sons, Ltd., Owen Sound, Ont., writes:

"It appears to us that the electrical transmission of power from waterfalls—the development of the power being by means of water-wheels acting on electric generators—is merely getting out of its infancy stage into boyhood, if we may so express it.

"When we look around and see the enormous amount of undeveloped water-power in Canada, we feel like saying that comparatively little has yet been done. Capitalists are, however, wakening up with commendable energy, and we truly believe that in the near future electrically transmitted power from waterfalls will be furnished cheaply to large manufacturing centres where steam is now principally used.

"The writer has designed a number of water-power electrical works, some of which are not yet in operation; but it is hoped that with a revival of business they, as well as other contemplated works, will be built at an early day.

"We may draw special attention to the immense, and almost unequalled, water-power, 30,000 horse-power, at Keewatin, on the Lake of The Woods, Ont., for which a magnificent stone dam has already been built, the intention being to transmit power electrically to the City of Winnipeg, nearly 120 miles distant, if a sufficient number of users of power in that city will agree to patronize The Keewatin Power Company to justify the construction of the transmission part of the scheme.

"The writer was the engineer for the construction of this dam, as well as the designer of the proposed water-power plant to be used there, and also for the plants used at the other works named above."

Canadian Electrical Association.

At the meeting of the Executive Committee of the Canadian Electrical Association, held on February 25, it was decided to hold the next convention of the association at Niagara Falls, Ont., on June 2, 3 and 4 next. Committees were appointed to make the necessary preparations.

Dead Man's Curve.

At the corner of Fourteenth Street and Broadway, New York City, is a double-track curve on the Broadway cable line. Below Eighteenth Street Broadway widens, and the road curves sharply to the southeast in order to take the curve into Fourteenth Street. Running along Fourteenth Street about 150 feet, the line again curves at a right angle into Broadway, the whole making perhaps the most dangerous and objectionable bit of surface road in America.

To further complicate the difficulties of the situation three separate lines of cross-town horse-cars intersect the cable road at the southern curve, and just at this point is the crossing over which flows the full tide of the Broadway and Fourteenth Street shopping crowd.

The sinister name, "Dead Man's Curve," which this particular locality has received from the daily press, seems to have been well earned. The cars, rushing at full speed around the short curve which crosses the Fourteenth Street footway a few feet from the curb, have had many victims, and pedestrians using the crossing are compelled to keep a careful lookout.

On Jan. 29 the Grand Jury brought an indictment against the Metropolitan Company for maintaining a nuisance at this point, and the matter is now in the courts. Popular interest in the subject, which has been continuously fomented by the daily press, has resulted in the submission to the municipal authorities of many plans for doing away with the curves, or providing some means whereby the cars can be operated at lower speeds around them. The curves are necessary in order to round the corner of Union Square, protruding into Broadway, which for four blocks loses its identity, to resume it again at Eighteenth Street near the northwestern corner of the park.

So long as the cable is used, especially when working under the strain of the enormous Broadway traffic, and around curves of very

"DEAD MAN'S CURVE."

short radius, it is impossible to release the grips on these curves, and the cars are compelled to take them at full speed with no ability to stop in case of emergency. The most obvious solution of the problem is to dispense with the curves by running the road straight across the corner of Union Square, either on the surface or in an appropriate tunnel. Other solutions which have been offered for the most part call for some rectification of the curves, but all that contemplate the retention of the present homogeneous cable system include some sacrifice of the park area of Union Square. This is so objectionable from many points of view that it is doubtful if the municipal authorities will permit any encroachment upon the park,

thus driving the railway company to the other alternative of adopting a different motive system for this part of the line.

A slow cable of moderate tension, extending through several blocks at this point and driven from the present fast-running cable, has been suggested, but does not seem to meet the approval of the railway company's engineers. The probability of delay and accident in shifting from one cable to the other would be considerably increased, and it is doubtful if this plan would be an unqualified success. It seems at best a makeshift.

The solution that perhaps will be the best for both the public and the Company is a change of motive power from cable to electricity. The continuous success of the Lenox Avenue conduit road in this city, and the admirable operation of another such system in Washington, D. C., have shown that such a system is eminently practical, reliable and satisfactory. There can be little doubt of its efficiency and operative economy, especially as compared with cable traction.

That this method of propulsion would greatly ameliorate the dangers of the Fourteenth Street curve is evident. The cars, instead of rushing violently around the short curves at full speed, would be under control and could be stopped instantly in case of emergency. The comfort of the passengers would also be greatly enhanced by a more deliberate motion on the curves, and the violent involuntary gymnastics of those compelled to stand would become a memory of the barbarous days of cable traction.

There are two other curves, almost equally dangerous, at Fifty-third Street and Seventh Avenue and Fifty-third Street and Ninth Avenue. At these points the streets are less crowded than in the vicinity of Union Square, and on this account the fatalities have been less.

Electric traction on Broadway possesses many other advantages over the present system. The element of danger is everywhere present, where cars are operated at high speeds in a crowded thoroughfare. The more manageable electric cars could be stopped more quickly, and controlled more easily than the cable cars, and, further, could make up lost time and keep more nearly to their schedule. Their ability to back out of a blockade would be no small point in their favor.

The equipment of such a line would present no new problem in engineering, and no very great difficulty. The presence of the conductors in the conduit would not interfere with the operation of the cable during construction, and doubtless the two systems could be operated simultaneously for a time until the cars were all equipped with motors.

From the point of view of the public the change would accomplish many desirable ends. The smoother movement of the cars, the lessened danger, the higher speeds possible on the uptown section, and the ease of extension of the electric system all commend it.

On the other hand, the Company would also gain by the change. The increased efficiency would reduce the operative cost, and the items of repairs and renewals would be lessened. Above all other considerations, the dangers of life and limb for the citizens and damage suits and indictments for the Company would be very greatly diminished.

The Metropolitan Traction Company is a very progressive corporation. Its experiment on Lenox Avenue has resulted in the letting of contracts for the equipment of the Fourth, Sixth and Eighth Avenue lines. The Company has even experimented with compressed air, with the usual result. If the equipment of these lines is a step toward the final electrification of the Broadway line, it is in the right direction.

If the public could be assured that this radical and satisfactory change will be made within a reasonable time, the agitation against "Dead Man's Curve" would probably cease. The curve, with all its dangers, is a necessary evil so long as the cable system is used and Broadway not rectified by cutting off the corner of Union Square.

The presence of a cable railway in this great metropolitan thoroughfare is an anachronism savoring of the Dark Ages. The Broadway franchise is probably the most valuable street railway concession ever made, and it is not an injustice to require the installation of the very best possible system, without regard to its prime cost.

Corporations Are Able to Manage Their Own Affairs.

The South Carolina Legislature, according to a recent press despatch, refused to pass bills placing telegraph and express companies under the control of the Railroad Commission, regulating the hours of labor on electric roads and others tending to interfere in various ways with the management of corporations.

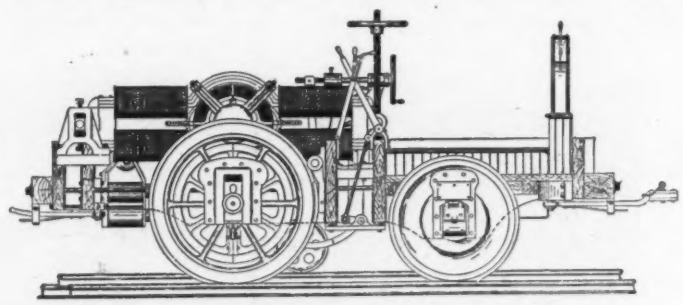
Some Opinions Regarding Electricity on the New York Elevated Railways.

In discussing the feasibility of applying electric motive power to the present system of elevated roads in this city, it is of the utmost importance first to ascertain the sentiment of the most interested party in the matter—the Manhattan Company itself.

With this object in view, a representative of The Electrical World called on Mr. William J. Fransioli, the general manager of the New York elevated railroad system. Mr. Fransioli was asked to express his opinion regarding the feasibility of substituting electric for steam power, and what would be the most important advantages to be expected from such a change. In reply he stated:

"At the direction of the president of our company, I made a tour of inspection to various cities where extensive electric traction systems are in use. I visited Chicago, where I made a most thorough examination of the Metropolitan West Side Elevated Railroad system, and found that the operation of this road by electric power has been entirely successful. Trains of four cars are operated from their terminal stations at one and one-half minutes' headway. The forward car of each train is equipped with motors, and acts really as a passenger-carrying locomotive. From this inspection I am thoroughly convinced that an electric system, perhaps, on these lines will in every way meet the requirements of our New York roads.

"It is extremely difficult at the present time to express any decided opinion as to the ultimate system of power distribution, motors, etc., which will be adopted. With alternating currents and high pressure, our central generating stations will be minimized, and could be located at a point where power could be most economically generated. The adoption of such transmission does not



Daft's "Ben Franklin"—1890.

necessarily require the use of alternating current motors for propulsion. Motor transformers located at sub-stations would be used if it were decided to adopt the present form of direct-current propelling apparatus.

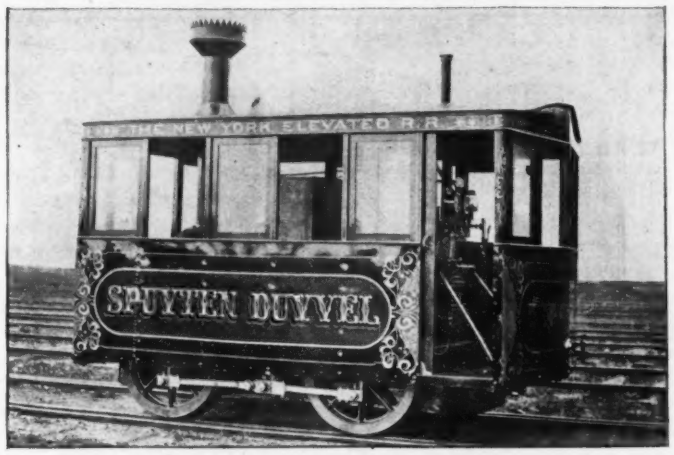
"The peculiar conditions of our New York system, the rapid collection of passengers at certain stations during the busy hours, seem to indicate that cars will be operated in trains consisting of about the present number of cars—four or five. I am hardly prepared to say what particular method will be adopted to propel these trains. A single passenger motor car acting as the locomotive of each train, similar to the Chicago system, will enable us to retain all our present methods, which we find essential to the satisfactory operation of the system. In using separate locomotives the difficulty of storage facilities arises, and the fact also here presents itself that such locomotives take up a great deal of track room, without being of any other service than propelling agents. With either of these methods the switching of the motor cars or locomotives at the terminal stations will be very much on the present lines. Those who are advocating the use of separate motors on each passenger car, the aggregate number of motors being controlled from one central source on the first car, claim the advantage of doing away with all switching and changing of motor cars at the terminal stations. Practice has shown that the time which would be required for switching on a new motor car or locomotive is far less than that necessary to fill the train.

"I believe that the adoption of electricity on our roads will undoubtedly give a more satisfactory service to the public for many obvious reasons, and the cost of operation will certainly be decreased, according to the system of power generation and transmission ultimately adopted. The aggregate results, however, from the practice we have seen fully warrants our serious consideration of electric power. The further question of the expenditure of funds needed for such installation is to be considered by the directors of

the company. In the event of the change, the Sixth Avenue line will probably be selected first and the equipment gradually applied. The old locomotives will probably go to many of the smaller roads or to the logging camps."

Prof. Sidney H. Short, of Cleveland, Ohio, writes:

"The chief thing to be gained, in my opinion, is a large reduction in the schedule time, with increased safety in operation. This will become more apparent when the surface roads shall have been equipped electrically. The elevated road must carry the passenger to his destination in much less time than the surface road, to invite him to walk some distance and climb the stairs to the elevated station. This can certainly be accomplished by the use of motors more easily than by the use of steam locomotives.



ELEVATED RAILWAY STEAM LOCOMOTIVE—1873.

"The electric motor will do away with a large part of the noise now made by the elevated trains. The more general distribution of the weight upon the elevated structure and the elimination of all reciprocating mechanism relieves the pounding effect, which is so unpleasant and injurious.

"With the motors properly constructed, no oil will drop to the street or on the iron work. There will be no water nor ashes falling to the street, which, with the locomotives, cannot be entirely prevented, notwithstanding that every precaution has been taken.

"I believe less coal will be consumed per train mile, but as this item is not a very large percentage of the operating expense, the saving cannot be great. A considerable saving will, however, be secured in the cost of labor. One man will operate the train instead of two. The total expense of repairs will be greatly reduced, both to the permanent way and to the rolling stock.

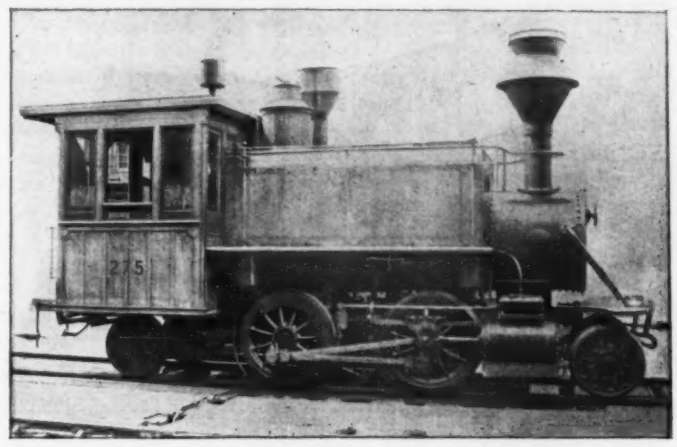
"One of the cars of the train should be the motor car. This car should be equipped with four motors, one to each axle. These motors should be able to accelerate the five-car train smoothly, without the slightest jerk, but very rapidly. The train should attain a speed of from 35 to 40 miles per hour in the shortest possible distance, using the maximum tractive effort of the motor car. The train should be controlled by a man on the front platform, using a special four-motor controller.

"The trains should be equipped with automatic safety air brakes, similar to those used by the steam railways. The air pump for this system will be operated by an independent automatic motor.

"The third rail should be adopted for the working conductor. This rail should be placed in position with special modifications and improvements which will prove most practical.

"It may be found advantageous to abandon stairways at the elevated stations, and provide electrically driven elevators, although there are many difficulties to overcome in the adoption of this plan.

"The method of power transmission and distribution will have to be determined by conditions yet unknown. It may be best to locate one or two power houses at some distance from the elevated roads, and transmit the power with alternating currents and transform into a direct-current at sub-stations, located conveniently.

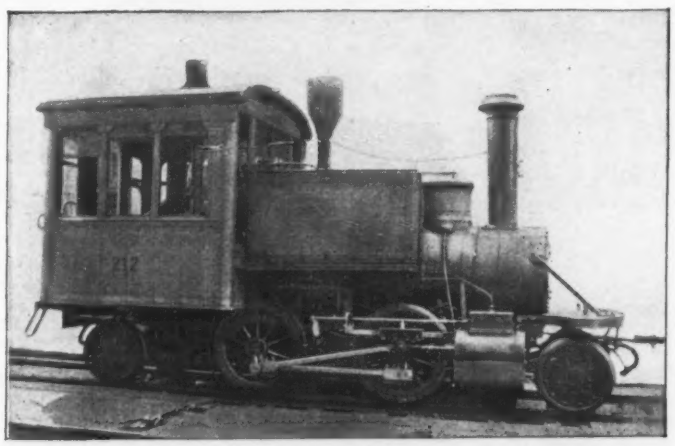


ELEVATED RAILWAY STEAM LOCOMOTIVE—1880.

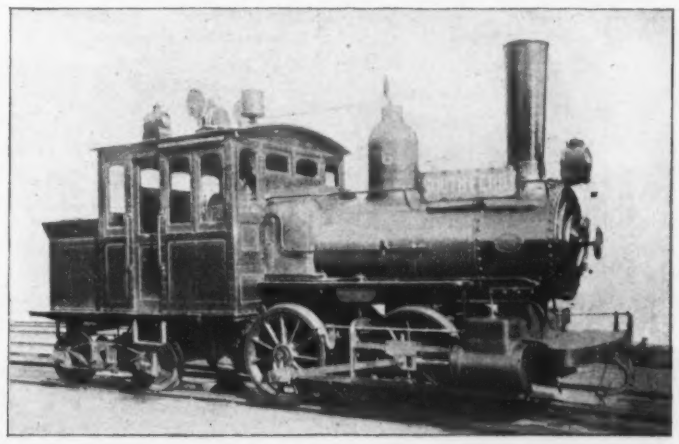
"Undoubtedly the adoption of electricity as a motive power by the elevated systems of New York City would greatly increase the travel, and, I believe, would be much more satisfactory to both the public and the owners of the Manhattan system."

Dr. Louis Bell expresses himself very briefly and in a characteristic way:

"I have no views about the particular change in question, except that it will be a good thing for both the road and the public. I hope that before long we shall get to be civilized enough to forbid, absolutely, the use of steam locomotives in our large cities. The American public tolerates, under the guise of commercial benefits, nuisances that would drive an honest Zulu to the warpath."



ELEVATED RAILWAY STEAM LOCOMOTIVE—1878.



ELEVATED RAILWAY STEAM LOCOMOTIVE—1893.

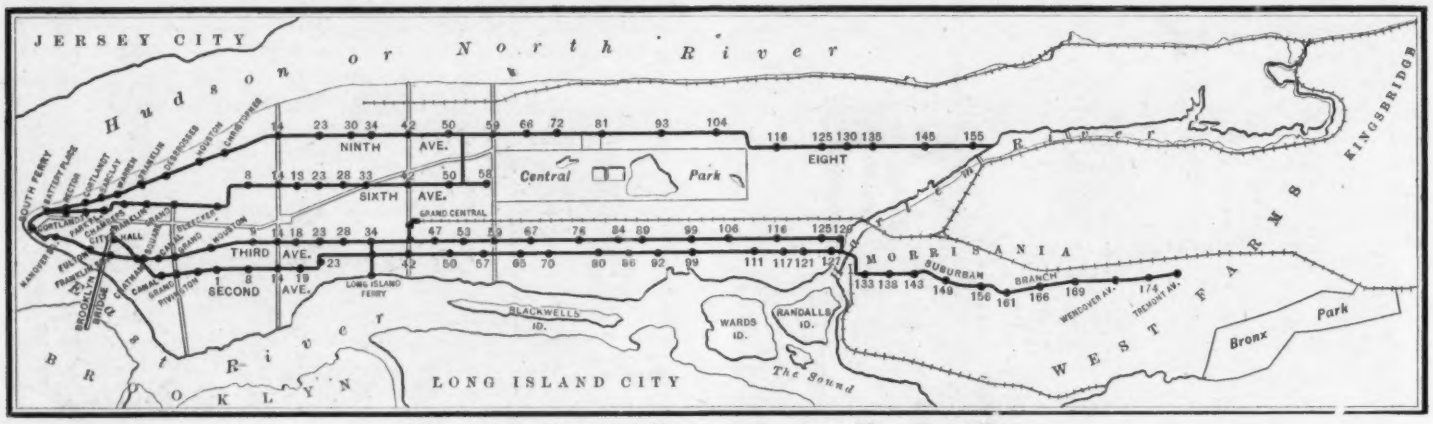
The following communication was received from Mr. Leo Daft, who was one of the pioneers in experimenting with electricity on the elevated railways:

"Had the request, just received from you by wire, been sent eight or nine years ago to the few men who were then deemed capable of giving an opinion of any practical value, from the electrical point of view, I have little doubt that most of the replies would have been less qualified than those you will now receive.

"Nevertheless, the latter will have more weight with practical railroad men than volumes of the rather impatiently confident assertions so common at the beginning of the last decade. In spite of the progress and splendid achievement which was the logical result of the unequalled activity induced by the 'broad gauge'

policy of street railway managers and municipal governments in this country, and in this country only, it may well be doubted if many experienced electrical engineers would not confess to a feeling of disappointment in the reflection that one may yet look in vain for that triumphant economical exhibit of actual electric railroad work, comparable with that demanded for the improved operation of the Manhattan Elevated Railroad system, which has so often been a bone of contention in dealing with that conservative corporation.

"The reason for this lack of parallel is evidently not far to seek, since that system is, in many respects, *sui generis*, and, perhaps, electrical engineers have justly incurred the oft-repeated charge of neglecting to treat the matter specifically, though there is, at least, one notable example of a painstaking and able analysis of the Manhattan system; but only those directly familiar with the tremendous strain imposed upon that great artery during commutation hours, can form an adequate idea of the real difficulties formerly attending an attempted solution of this problem by electrical means. To this ever-increasing strain the electrical fraternity is, doubtless, indebted for the noticeably greater consideration lately accorded to it by the elevated railway magnates, since it is now patent to every student of the subject that the comparative inflexibility of steam traction on a structure of sharply limited capacity will render an early recourse to electricity no longer merely desirable, but soon absolutely imperative, as the sole means of escape from an otherwise almost hopeless dilemma. In brief, we all know it to be a well-defined case where steam has reached its limit, largely due to the limitations of the structure, and equally we recognize the greatest electrical opportunity of the decade; for those who keep in constant touch with current electrical events and progress well know that with electrical machinery and equipments, now easily obtainable from several manufacturers, the management of the Manhattan Elevated Railway may economically maintain a continuous stream of fast-running units, for long or short groupings, which would not only increase the capacity of the present structure far beyond the ultimate limits assigned by its original designers, but restore its prestige to the old-time standard, even in view of the extraordinary popularity of the newly equipped surface roads."

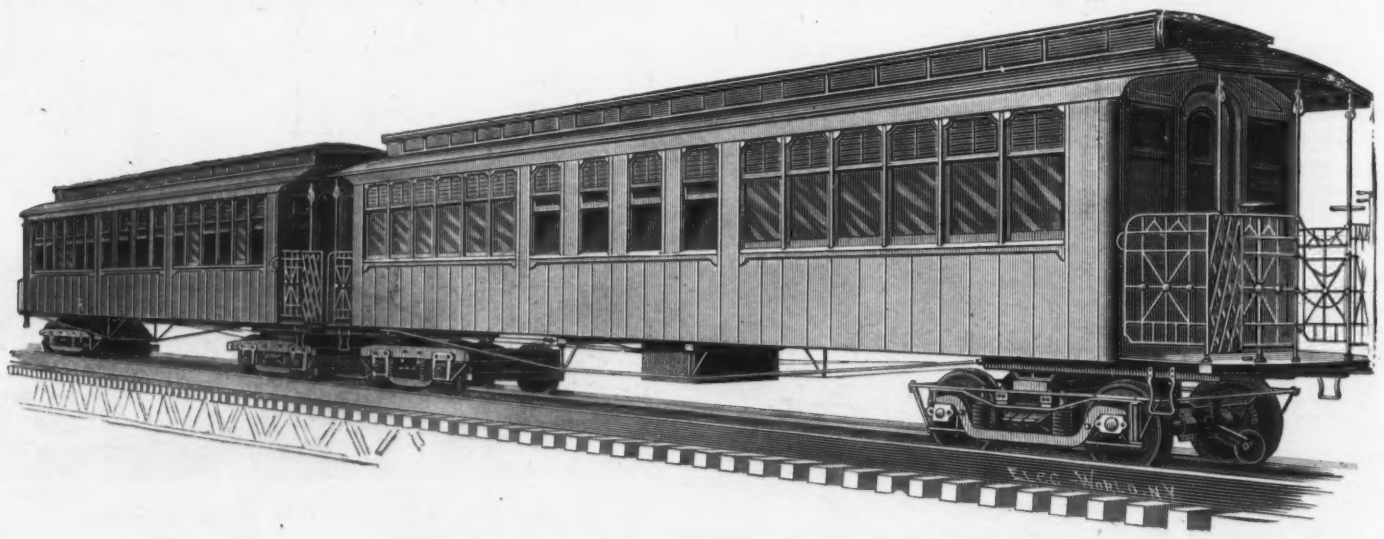


Map of the Elevated Railway Lines in New York City.

Electricity from Carbon Without Heat.

On the evening of February 24, 1897, Mr. Willard E. Case read a paper before the New York Electrical Society on the subject of "Electricity from Carbon Without Heat." Mr. Case first referred to the thermo-cells and the work which has been done in developing them. Such cells are of necessity limited in their efficiency by the second law of thermo-dynamics which provides that in the conversion of heat into work the efficiency equals the higher temperature minus the lower temperature divided by the higher temperature, all being reckoned from absolute zero, or minus 273 degrees centigrade. Mr. Case gave a comparative illustration of what the energy of coal does through the use of the steam engine as employed to-day and what it would do provided we could oxidize it in a battery without heat. The average of large electric light plants requires four pounds of coal for every horse-power-hour of electrical energy delivered from the dynamos to the line. Theoretically, 0.175 of a pound of coal will yield one horse-power-hour, or allowing for ash, 0.185 of a pound. If zinc, one pound used in a battery produces one horse-power-hour under a potential of two volts, including the loss in internal resistance.

The subject of electricity direct from carbon has been considered from many points of view. Some have attempted to obtain cheap electricity by using the oxygen of the air to oxidize various substances; others have attempted to oxidize coal by the oxygen of the air without heat, and others have attempted to oxidize coal by the oxygen of the air by the application of external heat.



Sprague Electric Railway System—Two-Car Train—1886.

Mr. Case said that he would pass over the carbon-consuming cells of Jablochkoff, Bard, Crumm, Edison, Wright and Thompson, and first describe the cell invented by Mr. C. S. Bradley in co-operation with Prof. F. B. Crocker, which was made by them in 1882. Mr. Bradley described the action of this cell in 1888 in a discussion of the subject "Electricity from Carbon Without Heat" before the American Institute of Electrical Engineers, as follows: "The cell consisted of fused sodium manganate and blowing a blast of air through it, by that means supplying it with oxygen and allowing it to act on the coal which is put in another part of the vessel, a little over one volt was obtained. The cell consisted of an

iron vessel 2.5 inches in diameter and six inches deep, which is placed inside of a retort and heated by a gas flame to nearly a red heat." The electrolyte of the cell is caustic soda, to which peroxide of manganese is added, forming a sodium manganate. In this cell is immersed the electrolytic carbon, which acts as the positive pole, and when the circuit is closed an E. M. F. of about one volt, with a current of three amperes, is obtainable. Mr. Case then stated that the cell described by Mr. W. W. Jacques is another illustration of the same principle involved in the Bradley cell, with a few simple practical modifications, the only real difference between them being the addition of peroxide of manganese to the bath of the Bradley cell. Mr. Case stated that experience with this type of cell leads him to believe that the theory of its action is not by any means well understood, and that the action is most uncertain and erratic, and seems to be more so before than after the addition of the manganese peroxide. He states that its E. M. F. seems to depend upon its temperature. If water is present when the caustic soda is first used, a reverse current becomes manifest. When air is blown through the electrolyte the E. M. F. is increased. Sometimes only 0.3 of a volt is obtained; sometimes about 1.5 volts, but the greatest amount of current is apparent when the carbon is immersed in the bath, and, curious to say, the highest E. M. F. is obtained when the carbon rod is drawn up along the inside of the vessel, and when this carbon electrode is replaced by another having none of the fused electrolyte on it and brought into contact with the exterior of the vessel at different points where the temperature varies, no appreciable E. M. F. is obtained. This would indicate that as the carbon is drawn up out of the bath against the side of a vessel, a point is approached where the critical temperature exists and the highest electromotive force obtained.

If a nickel crucible be used, as suggested by Mr. Bradley some years ago, the electromotive force is brought up to what is considered the theoretical. Mr. Case showed a small nickel crucible containing fused caustic soda and a carbon electrode the same as in the Jacques cell. When heat was applied the voltage went up to about 1.16, then began to fall, and at a critical temperature, above red heat, dropped to 0.3 of a volt, a most interesting fact, and on cooling, the voltage went up again to 1.16, and dropped again when the caustic soda solidified. Mr. Case said that it has been stated that the E. M. F. of the carbon-consuming cell was so low that it would be of no practical value. Experience with the storage battery in central stations in his opinion refutes this idea, at least for potentials up to 250 volts.

These cells, if correct in theory, can be heated without infringing on the second law of thermo-dynamics, as the law does not apply as long as the oxidation of the carbon itself produces only electricity.

Mr. Case stated that he believed that the question must be studied from a different standpoint than that of the past. In the first place, we certainly have a most wonderful example of the conversion of the potential energy of carbon directly into work in the animal economy which is developed at the expense of the oxidation of the material supplied by the food with an efficiency twice as economical as in the case of the steam engine. One-fifth of the potential energy is converted into work; four-fifths is converted into heat; but it is to be remembered that the human body must be able to exist in the Arctic regions as well as in the tropics. The engine-room must always be kept warm, and to insure this energy in all parts of the earth and under all conditions, the four-fifths of what apparently is waste energy is necessary to maintain the race. A day's work of muscular toil is stated by authorities to be about 1,085,000 foot pounds, while the daily expenditure in heat, although not readily determined, is estimated at 6,148,000 foot pounds.

In the human body the oxygen of the air is taken in by the blood and the lungs. It is carried through the arteries and attacks the tissues, giving up its oxygen and so oxidizing them, thus producing heat. When work is done, an equivalent of the heat disappears as work, and when the work is not done, the temperature rises, perspiration and evaporation take place, and the temperature is kept at its normal condition through this safety valve. In other words, expressed electrically, there is local action as in a battery. He believes that the action of Nature gives us the hint that we should follow its course likewise and prepare the material for our carbon-consuming batteries. The oxygen of the air we always have with us, so have we many carriers of oxygen, but an attempt, so far as he is aware, has not yet been made along this line, except that illuminating and other gases have been used.

Mr. Case then described a cell which was made by him in 1887. It consists of two electrodes, one of carbon surrounded by powdered carbon in a porous cup, and one of platinum, both being immersed in an electrolyte of sulphuric acid in a glass jar about one inch in diameter and six inches in height. Into this electrolyte, when chlorate of potash is introduced, peroxide of chlorine is formed, which is a very unstable gas, and decomposes in the presence of carbon, its oxygen attacking the carbon, oxidizes it without heat, and chlorine being set free at the platinum pole, electricity is generated at an E. M. F. of 1.3 volts, varying with the amount of oxidizing agent present and the amount of carbon used. But these two electrodes may be placed in the vessel containing water and the gas generated outside of the cell, passed over into the cell containing the electrodes, in which case it will act the same as before; the internal resistance being regulated by the amount of sulphuric acid added to the water.

Mr. Case stated that we have been taught to believe that the E. M. F. due to the oxidation of carbon is about 1.05 volts. This value has been arrived at by assuming Andrews' determination that the oxidation of one pound of carbon to CO_2 equals 14,554 B. T. U. This determination was only approximate, and further it was a determination made with a very high temperature. In the cell last mentioned, an E. M. F. of 1.3 volts was obtained, so that it would apparently appear that there are more foot pounds of energy in a pound of carbon as shown by Andrews; unless the additional energy in this instance comes from peroxide of chlorine, it might be thought that the high E. M. F. obtained in this cell is due to the action of the nascent chlorine on the battery. But careful measurements have determined the contrary. Mr. Case stated that we have, therefore, a cell in which carbon is oxidized without the application of heat and with normal temperatures; a cell in which oxygen in unstable composition is readily given up to the carbon, and the product of the oxidation is carbonic acid gas, as proved by analysis. He thinks, therefore, that we have the right to assume that a large per cent. of the potential energy of the carbon is converted into electrical energy. A point which he wished to make in this connection is, we have in the cell conditions which are analogous to those taking place in the human system, at least to the extent that carbon is or can be oxidized at the normal temperatures in which we live, and its potential energy converted into electricity. Mr. Case stated that he could see no reason for the use of high temperatures, and that every endeavor should be made to keep without the second law of thermo-dynamics. Search should be made for a suitable carrier of oxygen or some cheap source of oxygen supply and hydrogen or carbon, or a carbon compound easily oxidized.

Mr. Bradley, in the discussion which followed, said that he had met with many difficulties which it seems had not occurred to Mr. Jacques. The accumulation of the ash from the coal was a very serious matter, and will in time clog the batteries. Also, after a short time Mr. Bradley found that the electrolyte became hardened. He believes it was due to the formation of carbonate of soda, but had no means of verifying this supposition. He says that chemistry has not yet afforded the means or shown a way, or we have not ingenuity enough to see the way to find substances which could be readily separated from the ash, and at the same time would not absorb the carbonic acid developed by the carbon in its combustion.

Prof. Crocker stated that the advantage of nickel over iron is easily explained as indicated by Mr. Case. Caustic has very little action on nickel, while iron, on the other hand, seems to be dissolved more or less when combined with the caustic, and produces not only a complicating action, but probably an opposing action. If the negative electrode is dissolved as well as the positive they would tend to set up a counter E. M. F. and interfere with the real action, so that the securing of an inert negative electrode is, in his opinion, an essential element in any successful battery.

Prof. Crocker stated that it may be that all these peculiar phenomena noticed by Mr. Case are due simply to the action of the caustic on the iron under different circumstances, and that he is inclined to think that is the case. The constancy of the nickel crucible is easily explained by its non-action; but the phenomenon pointed out by Mr. Case, namely, the peculiar dropping off of the E. M. F. at a critical temperature above red heat, is not explained by any property of nickel which is known, or any phenomenon, chemical or physical, that is recognized. It may possibly be due to the driving off of the oxygen at that temperature of the electrolyte, but that would not explain the fact that the E. M. F. comes up again on cooling.

Destruction of a Power House in Philadelphia by Fire.

The great power-station of the Union Traction Company, Philadelphia, at the corner of Thirteenth and Mount Vernon Streets in that city, was destroyed by fire on the evening of March 3. The following facts concerning the disaster are taken from a Philadelphia paper:

A few minutes after 6 o'clock the hook on one of the traveling cranes, used in the building of a new dynamo, through some accident touched the armature of a running generator, No. 9, and short circuited it. The rapidly revolving armature, with a capacity of 2000 horse-power, was melted down at once and a shower of sparks and melted metal was thrown over the floor. The oil-saturated woodwork caught fire in a second, and the flames leaped high along the wall dividing the generator room from the boiler house.

For a few moments the men in the dynamo room, about twenty-four in all, sought to fight the fire with the hose reel and buckets, in the use of which they had been drilled, but to no effect. The room filled with smoke, and they hurried out of the building just in time to save their lives. Behind them the great engines and dynamos that gave the current to half the car lines in Philadelphia whirled on silently. There had been no time to stop them.

The men were hardly outside the door when the main steam-pipe, softened by the heat of the flames, burst. The force of the explosion lifted the roof off the building, and broke many windows in the neighborhood.

Two miles away people on the street could hear the deep roar of the escaping steam and feel the air throb.

The boiler house, in the rear of the power-house proper, had been separated from the dynamos by a high wall, against which the flames first appeared. It was not long before the roof had fallen in on the big boilers.

The firemen had to do all their fighting from the outside. In two hours their work was over, and a litter of smoking embers was all that remained of the combustible parts of the plant.

The total loss is estimated at $400,000. The property was fully insured. In the stampede caused by the explosion two men were killed.

Electric Railways in Europe.

Mr. Thomas Ewing Moore, commercial agent for the United States at Weimar, Germany, has submitted to the State Department, Washington, an interesting report concerning electric railways in Europe. He states that electric locomotion is gradually gaining ground in the various European countries, though not to the same extent as has been the case in the United States. During the year 1895 the total number of electric railways, or tramways, in Europe rose from 70 to 111; the length of lines from 435 to 560 miles, and the output of the "centrals" from 18,150 to 25,095 kilowatts, while the number of cars increased from 1236 to 1747.

The mileage of electric railways in the principal European countries is as follows: Germany, 252 miles; France, 82 miles; Great Britain and Ireland, 66½ miles; Austria-Hungary, 44 miles; Switzerland, 29 miles, and Italy 24¾ miles. Servia, Russia, Belgium and Spain have but from 6¼ miles to 18½ miles, while the remaining countries have less than 5 miles each.

Of these 111 lines, 91 are operated on the overhead surface system, 12 on the underground system, and 8 by means of accumulators. It is estimated that the new lines projected for the present year will exceed in number and mileage those constructed during any previous year. Considerable activity exists in planning and laying out new routes.

The capital invested in electric lines in Germany alone is estimated at $23,800,000. German electrical companies and supply manufacturers have greatly increased in number and capital during the past few years. Berlin is about to introduce general electric locomotion in its streets, and the electric street railways in Hamburg and Leipsic are about completed.

The overhead system, Mr. Moore states, will be preferred for the lines contemplated, or in course of construction, on account of its cheapness.

Voltage Required for Rontgen Rays.

According to recent experiments of Prof. Trowbridge with a 20,000 volt storage battery, it appears that the lowest voltage which will produce satisfactory Röntgen rays is about 100,000. He also found that electrostatic polarization is largely instrumental in the generation of X-rays.

Meeting of the Societe Internationale des Electriciens.

At the meeting of the Société Internationale des Electriciens, on Feb. 3, M. L. Colin gave a description of some new forms of electric-heating apparatus. The wires in the heater range in size up to one millimetre diameter and are covered with an insulation consisting largely of ground glass. The wire may be operated at a temperature of 350 degrees C., the insulation not being fusible below 800 degrees C. Experiments have shown that an expenditure of 100-watt hours will develop 86.5 kilogramme degree calories. A surface of one square decimeter will consume 100-watt hours and liberate 86.5 calories. In chop grils and chafing dishes, where a rapid heating is desired, it is necessary to liberate about 120 calories per square decimeter of the gril; the energy expenditure is then about 140 watts per hour. The kettle heater requires a temperature of about 450 degrees C. in the wires.

Experiments have demonstrated that a square metre of surface is capable of vaporizing about 100 kilogrammes of water per hour. The quantity of heat liberated should, therefore, be about 536 calories per square decimeter, and with an expenditure of electrical energy of about 6 hecto-watt hours. Some experiments have shown that an efficiency of 80 per cent. may be attained. This apparatus is being employed on 110-volt circuits, and takes from 2.25 to 8 amperes according to dimensions.

M. F. Bonfante read a paper on interior electrical construction. To avoid the dangers which exist when wires exist in the neighborhood of metallic surfaces, he proposes to use a concentric system of cables with the exterior grounded for the purpose of causing short circuits, thereby blowing the fuses in case of trouble. The idea met with many protestations.

The Telegraph of the Future.

Prof. W. E. Ayrton, in a recent interesting lecture, in London, on submarine telegraphy, ventured the following remarks concerning the future: "There is no doubt the day will come, maybe when you and I are forgotten, when copper wires, gutta-percha coverings and iron sheathings will be relegated to the museum of antiquities. Then when a person wants to telegraph to a friend, he knows not where, he will call in an electromagnetic voice, which will be heard loud by him who has the electromagnetic ear, but will be silent to every one else, he will call, 'Where are you?' and the reply will come loud to the man with the electromagnetic ear, 'I am at the bottom of the coal mine, or crossing the Andes, or in the middle of the Pacific.' Or, perhaps, no voice will come at all, and he may then expect the friend is dead. Think what that will mean. Think of the calling which goes on from room to room, then think of that calling when it extends from pole to pole—a calling quite audible to him who wants to hear, absolutely silent to him who does not."

Foreign Duties on Electric Machinery and Lamps.

The State Department, Washington, has issued a statement taken from the British *Board of Trade Journal* for January, 1897, showing the rates of import duty leviable on dynamo-electric machinery and electric lamps in the principal European countries and India. The countries named are Austria-Hungary, Belgium, Bulgaria, Denmark, France, Germany, Greece, Holland, Italy, Norway, Portugal, Roumania, Russia, Spain, Sweden, Switzerland, Turkey, the United States and India. This is a valuable compilation, and all interested in the electrical export trade will find it to their advantage to procure a copy.

The First Transatlantic Message.

In connection with the arbitration treaty under consideration at present, it is interesting to recall the first messages which were sent through the Atlantic cable. This was on August 5, 1858; the Queen telegraphed to the President that she hoped that the electric cable would prove an additional link between the two nations, to which the President replied, "May the electric telegraph, under the blessing of Heaven, prove to be a bond of perpetual peace and friendship between the two great nations."

Interior Conduits.

(*Continued from page 291.*)

Prof. William A. Anthony writes:

"The conductor should be insulated for the reason that in the installation of any conduit system it would be nearly impossible to secure a perfectly continuous insulation in the conduit on account of the numerous joints, connections to junction boxes, etc., that must be made in place. There should also be an insulating lining in the tube, as this would furnish an additional safeguard against possible imperfection or injury to the insulation on the wire, and would permit the use of thinner insulating covering, hence, a more flexible and more easily handled conductor. A given thickness of the insulation divided between the wire and tube would increase by thousands of times the chances against occurrences of any defect that might impair the insulation, since the chance that any defects in both insulations would coincide when the conductor was drawn into the tube, would be extremely small; while if the insulation were entirely on the wire or entirely in the tube, any defect would involve the whole insulation.

"I do not consider a coating of asphalt paint of any adequate protection against any danger to the insulation. A coating of enamel of sufficient thickness applied to a pipe that has been thoroughly cleaned, so as to present a metallic surface, free from oxide, might prevent rust and the abrasion of the insulation on the conductor, but such a coating as would serve these purposes would not allow of bending, would be brittle and liable to be cracked in the handling ordinarily incident to the installation of the conduit. Nothing will prevent collection of moisture except complete exclusion of damp air from the conduits before and after drawing in the conductors.

"I do not consider an extra covering on the conductor for the purpose of mechanical protection is of any advantage in any case. Such a covering renders the wire less flexible, less easily handled and more liable to injury while being drawn into the conduit. With my present light upon the subject, I should say it would be at least equally safe to draw into a plain iron pipe a standard wire used for interior conduit work, as to draw into the same conduit a heavily covered wire like 'Attix,' assuming the pipe to be sufficiently large for the latter.

"Lead covering might be of advantage in a plain or merely coated pipe, but would be useless in a pipe having an insulating lining.

"I consider a lining of some thickness more than a mere coating necessary to separate the insulation of the wire from the iron. If the lining is firm and hard, not easily abraded and impervious to water, a thickness of 1-32 of an inch is sufficient.

"I believe in an insulating lining in the tube as an additional safeguard, and the higher the insulation resistance of the lining the better. I should say that a piece of conduit ten feet long should, after standing full of water for several days, still show an insulation resistance up in the megohms.

"I consider plain or merely coated iron or steel tubing inferior under any conditions, whatever may be the insulation of the conductor."

Mr. Reginald Pelham Bolton, consulting mechanical engineer, Syndicate Building, New York City, writes as follows:

"The broad response to your interesting letter is that the matter of interior lining of conduit is less an electrical than a practical matter.

"Conduit we must have, and a system of removable leads. There is, however, no common sense in insisting upon insulation on conductors and equal insulation inside the raceway. Either the interior lining is good enough for a system of bare wires, or it is not.

"Abrasion of conductors in a plain pipe is a mere bugbear. The relative sizes of interior area of equal-sized pipes has far more to do with the successful pulling of the conductors. The insulation on the latter has been injured more by the melting of the lining, which seems an inevitable circumstance in most installations.

"A lead-covered insulation is an anachronism, only necessary to comply with Fire Department demands, but even so, it is easier to pull and costs less combined with plain tubes.

"There really seems very little reason in taking elaborate precautions with the interior of a tube, when the protection of every pull-box or outlet is merely a little enamel paint.

"Your queries miss the essence of the question at the present period, which appears to lie in the fear of the authorities and of others, that the admission of rubber insulated conductors in plain tubes, will throw open the field of construction to pipe-fitters and bell-hangers. While it is true that the manufacturers of interior conduit have earned the gratitude of the public by their maintenance of a good standard of material, it is sorry work to block reasonable methods for such reasons as above cited.

"I doubt the advisability of the present and of proposed cast-iron rules, since improvement is continuous, finality is far distant, and the whole system of conveyance of electric energy is liable to radical change. I could make suggestions of a really practical system of supervision and control of installation, which would take the place of the present clumsy system of rules, if the authorities evinced any desire to attain such a result."

Prof. D. C. Jackson, University of Wisconsin, Madison, Wis., writes:

"The satisfactory interior conduit must be a perfectly smooth runway which will resist mechanical injury through the carelessness of workmen or others, which may be bent, cut, etc., with ease and safety, and which will have no deleterious effect upon the rubber insulating materials. Plain iron pipe can be made to fulfill each of these requirements, but the expense and care required will probably be as great as that required in inserting the usual conduit linings. I am of the belief, however, that a cement or enamel lining (similar, for instance, to that used in some underground conduits) might be used with great satisfaction and that, as in the case of the underground ducts, the iron pipe need not be so thick as standard iron pipe."

Mr. Frederick S. Minott, manager of the electrical department of the National India Rubber Company, Bristol, R. I., writes as follows:

"We would suggest that some attention be paid to the inside diameter conduits, as we believe that No. 14 wires insulated according to underwriters' rules should not be drawn through a ⅜-inch conduit.

"The diameter of a No. 14 B. & S. wire insulated with 3-64-inch rubber wall is 0.157 inch; two such wires separately braided with strong yarn should measure not less than ⅜ of an inch, and the conduit, we believe, should measure not less than ⅝ of an inch.

"The insulation should be on the conductor, and as an additional precaution might be of benefit in the tube.

"In case the insulation on the wire should be faulty, through defect in manufacture or mechanical injury, the insulation in the tube would be of advantage.

"A number of coatings of good preservative compound, we think, would prevent oxidation; we are unable to say that it would prevent moisture, but think that it would prevent abrasion if the tube is of sufficient size and carefully made.

"We think an extra covering on the insulation of the wire in addition to a thin coating of preservative compound is not necessary, provided the wire is carefully insulated, carefully tested, is strong and flexible."

Mr. Minott does not think that a lead covering on the conductor is necessary, nor does he consider it necessary to have a thick lining in the tube. He states further that he believes in an insulated-lined conduit, the insulation resistance of the lining being depended upon as an additional safeguard. Both insulations should be as near perfection as possible. He does not believe that an absolutely plain iron or steel tubing is sufficient, but should be coated with some good preservative composition.

Mr. Alexander Dow, general manager of the Edison Illuminating Company, Detroit, Mich., writes: "In general I prefer to put the insulation on the wire, and ten years' experience with rubber insulated wire pulled into iron pipes has convinced me that any pipe which will not rust is good enough. Fins and burrs are, of course, inadmissible and inexcusable in pipes for conduit work. The separation between the copper of the conductor and the iron of the pipe should be enough to prevent lightning selecting that path instead of the air gap of the lightning arrester. Whether the mechanical separator used to secure the proper distance is put on the wire or in the pipe is of no electrical consequence."

Mr. William McDevitt, chief of Electrical Department, Philadelphia Fire Underwriters' Association, Philadelphia, Pa., writes that great credit is due to those who introduced the conduit feature in electrical work, no matter what defects were developed after its introduction. He awaits the innovation of a conduit with insulation that will permit of the use of a bare conductor.

Mr. A. V. Abbott, chief engineer of the Chicago Telephone Company, Chicago, Ill., writes that he believes the insulation should be on the conductor, and that there is no advantage in an insulated-lined tube provided the insulation on the conductor can be depended upon. He believes that it is quite possible to make a coat-

ing of enamel which will prevent oxidation, moisture and abrasion, but in the present state of the art it is improbable that a sufficiently good coating would be furnished at the prices for which interior conduit is now sold. He thinks that lead-covered conductors are admitted by all electrical engineers to be the best form of conductor for all purposes. He does not believe that the insulation resistance of the lining of an insulated-lined conduit should be depended upon as an additional safeguard. He believes that an absolutely plain iron or steel tubing is sufficient when well-insulated lead-covered conductors are used.

Messrs. Ross & Hailey, 35 Centre Street, New York City, write that they believe the insulation should be on the conductor, and that nothing is gained by having an insulating-lined tube, while the cost is increased. They do not believe that asphaltic paint, enamel or other substance is necessary as a coating, if the conductor is well insulated and protected with an armor of some kind, such as a good, heavy tight braiding of cotton, manilla or other strong fibrous substance. They believe that an extra protective covering on the insulation of the conductor is sufficient. They do not approve of lead-covered wires, neither do they believe that a lining acting as a distance-piece between the pipe and insulation on the wire is necessary. They do not believe in an insulated-lined conduit, but that the insulation should be on the wire. They think that a small, plain iron or steel tubing is sufficient, without any inside coating of any substance.

Mr. Charles Ackerman, Bennett Building, New York City, writes as follows:

"There are a number of different insulating materials and paints from which electricians can choose, and for what I consider merely as non-conductors of electricity, some of these preparations are very good, but for places exposed to friction or to heat, especially heat produced by the current itself, they nearly all fail, being either too soft or too combustible, or having both bad qualities together, and in some cases the third bad quality of defective insulation added. What is really needed is an insulating material combining the qualities of high resistance, hardness, durability and perfect incombustibility at any chance heat to which the insulating material may be exposed. With the great increase of buildings electrically wired for both light and power, the increased danger of fires is becoming so threatening that better and safer insulation is really imperative. Enclosing the conductors in iron pipes has been practiced to some extent in the wiring of buildings, but oftentimes the operation of drawing the wires through the pipes results in making one or more small and generally unnoticed breaches in the insulating coating or lining.

"The experiments in conduit insulation have been carried on with great energy by electrical engineers in Chicago, New York, London, Berlin and Paris, and much has been done to perfect insulation. Iron tubing has offered the best covering, since conductors so secured cannot be injured by nails.

"I believe the insulation should be on the conductor, unless the pipe can be lined with a material that cannot be injured by bending the pipe or drawing the conductor through it. Lining both the pipe and covering the conductor with insulating material is better on account of the double security.

"For insulation I prefer to dispense with all combustible material as far as possible. When the insulating lining in the pipe and on the conductor are hard enough and tough enough to resist the abrasive action of drawing the conductor through, I should dispense with lead covering.

"I think a thin coating of hard enamel sufficient, without any additional distance between the pipe and the insulation of the conductor. In all cases I should prefer to have the steel or iron pipe coated inside and out. If not coated outside it might act as a conductor from the iron in the construction of the building."

Mr. J. C. Hatzel, of Hatzel & Buehler, electrical engineers and contractors, 114 Fifth Avenue, New York, writes that the insulation should be on the wire, and not in the tube, but that a proper insulating lining to the tube prevents oxidation and injury to the wire while being drawn in. He states that a thin coating of asphaltic paint, enamel or other substance will not be sufficient to prevent oxidation, the collection of moisture or the abrasion of the insulation on the conductor, as in all probability the surface would not remain intact, but in the drawing in of wires its surface, unless very hard, would be very likely to injury by the friction of the conductor against the sides when pulling around elbows and bends. Were it sufficiently hard to withstand such injury, bending or hard usage would be very likely to crack or scale the surface. He believes that an extra protective covering on the insulation of the wire would be of no additional value, except as an extra precaution against abrasion in drawing in. He does not think it necessary to have a lead covering on the wire under any circumstances, in fact considers it a detriment, as it is more difficult to make connections at outlets, more readily injured by accidents or carelessness, and such injury often creates more serious results than on a conductor without lead covering. He believes that the thickness of the lining of the conduit should depend upon the character of the lining, upon the size of the conduit, which naturally depends on the size of the conductors to be inserted, or, in short, the amount of current the conductor will carry in a particular sized conduit. He does not consider that an absolutely plain iron or steel tube is sufficient, but that the same should have a lining. To sum up, in his opinion an ideal conduit would consist of an iron or steel tube sufficiently heavy to prevent all mechanical injury and withstand the strains to which it is subjected in the course of construction in our present fireproof buildings. The tube should be lined with a substance or material which will not soften or crack in extreme variations of temperature; will not soften or become pulpy when subjected to moisture, and sufficiently flexible to permit of bending without crimping or cracking, and at the same time, under normal conditions, possess an insulation resistance sufficiently high to prevent excessive leakage were a bare conductor installed.

Mr. A. A. Hamerschlag, of Hamerschlag & Company, 26 Liberty Street, New York, writes: "Judging by our experience we favor iron pipes having insulating material for the inner tube, as we believe it not only prevents abrasion to the wires, but when finished also insures as high insulation resistance as could be desired. Mechanically it makes a good job, and the iron pipe is an almost certain safeguard against abrasion of the wire due to pressure. An inner coating of paper or other insulating material certainly protects the wire as well as insulating it. For subway or external conduits, we are inclined to favor a heavier insulation on the cable with a lead-covering, to prevent abrasion and facilitate finishing as well, to make it somewhat more moisture-proof. In the event of the use of the latter, we do not think an insulating material in the tube at all necessary."

A New Method of Operating an Induction Coil.

To the Editor of The Electrical World:

Sir:—Since the induction coil has come into prominence through the discovery of the X-rays of Röntgen, considerable attention has been turned toward devising some method of operating which is applicable to long runs, on a voltage such as is furnished by electric light mains, 110 or 220 volts. The more recent forms of break work well with storage batteries, but these are troublesome, and a break which will work satisfactorily on the voltage of ordinary electric light mains is yet to be supplied. The following method has been devised to meet these difficulties:

A condenser of considerable capacity is first connected to the lighting mains and charged at 220 volts. It is then disconnected and discharged through the primary of an induction coil. The charging and discharging of the condensers is effected by means of a commutator. In this way the only current passing through the coil is from the condenser. The commutator is on the shaft of a small fan motor.

A six-inch Ritchie coil connected in this way with a condenser of 25 microfarads, its own condenser being disconnected, gives a thick, fuzzy spark about two inches long. Removing the primary of the coil and replacing it by about seventy turns of rather heavy wire, No. 8 or 6 B. & S., we get a multitude of fine zig-zag sparks about six inches long, the discharge being identical in appearance with that from an induction coil worked in the ordinary manner under the best conditions. The introduction of iron, unless finely laminated, cuts down the discharge to about one-tenth its value. Increasing the speed of charge and discharge of the condenser up to about 2000 per minute, which is the limit of the very crude commutator at present employed, improves the discharge of the coil in quantity and voltage. The sparking on the commutator is very slight and the amount of power taken from the mains is small.

The discharge obtained in this way, so far as we can now judge, seems well suited for driving X-ray tubes. Tubes so operated produce a brilliant fluorescence on the screen, with strong, sharp shadows. An exposure of twenty seconds gives a good radiograph of the hand.

Charles L. Norton.
Ralph R. Lawrence.
Massachusetts Institute of Technology, Boston, Mass.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of the Iron Losses in Toothed Armatures. BRESLAUER. *Elek. Zeit.*, Feb. 11.—A short article in which he develops an accurate and simple method of calculation based on the Steinmetz law; difficulties arise in the fact that the teeth are narrower at the roots than at the ends; he points out the errors in the usual method and in the one in which one-third of the smallest saturation is added to two-thirds of the largest, as is frequently done in practice; the correct solution shows that both of these lead to quite incorrect results. With the aid of the differential calculus he evolves a formula, and the following rule: The losses should be calculated for the smallest saturation and the weight of the teeth, and the result is then multiplied by a factor which is dependent only on the ratio of the smaller to the larger width of the tooth; this factor is not very easily calculated, and he therefore gives its value in the form of a curve, for each value of the ratio, thus enabling the final results to be calculated very easily. The above applies to teeth of the usual shape, with spaces having parallel sides; he then discusses the case in which the spaces are circular, with a small opening at the top; the calculation is the same, except that the above-mentioned factor is different; a second curve gives the values for this factor in this case.

The Graphical Calculation of Induction Motors. DANIELSON. *L'Eclairage Elec.*, Feb. 6; translated from the *Tecknisk Tidskrift*, April 13, 1895.—He applies the graphical principle to the calculation of a three-phase non-synchronous motor. It is followed by an abstract of a discussion by Heyland.

Armature Reaction in Alternators. KANDO. *L'Ind. Elec.*, Feb. 10.—A French translation of the article abstracted in the *Digest*, Jan. 2.

Test of the 200 kw Turbo-Generator. HUNTER. Lond. *Elec. Rev.*, Feb. 19.—The results of a test, given in the form of curves and a table, of a Parsons generator; on full power trials the water used per electrical horse-power hour, when exhausting into the atmosphere, was 32.22 lbs.; with steam superheated 30° F. the consumption was 30.97 lbs.; with saturated steam and exhausting into a condenser it fell to 19.51.

Rotary Converters. BERG. *Amer. Elec.*, Feb.—A general summary of the principles involved in the rotary converter. The effective alternating voltage of rotary converters is 71 per cent. of the delivered continuous current E.M.F. in the single phase and two-phase systems, and 62 per cent. in the three-phase system, these values applying to an impressed E.M.F. of sine wave variation. The high output and good commutation of rotary converters are due to the fact that the alternating and continuous currents to a certain extent flow in opposition to each other, and thus the resultant current, and consequently the heating, is less than in a corresponding continuous current machine; the armature reaction, due to the continuous current taken out of the machine, is opposite and approximately equal to that of the alternating current put into the machine, the resultant reaction thus being small. Rotary converters with compound field windings are preferable for use in electric railway service; a shunt excitation is adapted to conditions of lighting where the voltage of the converters is to be varied independently of the load, when regulators or boosters are also employed; rotary converters without any field excitation are stated to have no advantage over either of the other two types except as to cheapness of construction. In rotary converters with shunt and series excitations, self-inductance, which usually is considered objectionable in alternating current circuits, is desirable and even absolutely necessary to automatically control of the voltage; an example is calculated showing that in a machine of which the data is given, the power factor may be largely increased by the addition of 30 per cent. of artificial inductance.

Dead Wire on Armatures. ANTHONY. *Elec. Eng.*, Feb. 24.—A short article replying to the one by Pfund which was noticed in the *Digest* last week. The question whether a given portion of the wire on an armature is dead or not depends not so much on whether it is actually cutting lines of force as upon whether it can upon proper design be made to aid in producing a higher voltage or can be dispensed with, thereby reducing the resistance; there is no question that the voltage of the machine is measured by the mean rate of change in the number of lines of force that pass through the area enclosed by the armature coil, and it is impossible for the lines of force to get into or out of this area without cutting the wire somewhere, but it is immaterial where; he concludes that the inside wire is not dead in the sense that it is useless unless it is unnecessarily long to enclose the given area. He then refers briefly to Hering's experiment; (it may be said here that in the original article by Hering, which has given rise to these discussions, the terms "active" and "inactive" were used, and it was distinctly explained that the wire was not dead in the sense of being useless; the object of the article was to show that the generation of the E.M.F. was greatest where the rate of cutting lines of force was greatest, thus showing that the theory of cutting lines of force gave a more complete and satisfactory explanation than the theory of the rate of change in the number enclosed in the area; it was stated in the original article that both theories were undoubtedly correct). He adds that Pfund's figures and explanation show that he has some erroneous idea about the development of E.M.F. It is followed by a brief communication by Boyrer, in which he states that Pfund's methods of obtaining his results are somewhat misleading; he (Boyrer) concludes that the wires on the inside of the ring armature generate more or less E.M.F., which is always antagonistic to that of the generator.

Dynamo Characteristics. STINE. *Amer. Elec.*, Feb.—Methods for the practical determination of dynamo characteristics are given, and their practical use pointed out. It is recommended that electricians employed about dynamos should obtain characteristics of their machines, which characteristics will be of the same service in the case of faulty running that the indicator card is to the steam engineer.

Designs for Small Motors. POOLE. *Amer. Elec.*, Feb.—The design of a one-sixth hp motor with drum armature, accompanied by working drawings and directions for the construction of the motor.

LIGHTS AND LIGHTING.

Lamp Filaments Treated with Boric Acid. WILLIAMS system. *L'Elec.*, Feb. 13.—A description of this method for treating the carbon filaments of incandescent lamps with boric acid. The reason why the methods have heretofore been unsuccessful was that the boric acid was not properly prepared; it should first be fused at a white heat, for two or three hours; when cold, it is pulverized, in which form it is placed on the filament with the aid of a little water, after which the filaments are heated, when they will be found to have become quite white; they are then carbonized in the ordinary way, after which the filaments are dipped into benzine and dusted with the calcined boric acid; they are then placed in a glass bulb and connected to the electric terminals; the air is exhausted, after which the vapor of benzine is introduced in the usual way; the bulb is then again exhausted and a gradually increasing current passed through the filament until the voltage is much higher than the normal, after which they will be found to have a fine metallic appearance. If the filaments are made of a liquid or semi-solid material the pulverized calcined boric acid is mixed with this material in as large a quantity as possible. He also uses this acid for arc light carbons, the calcined material being simply mixed with the powder before carbonization.

Projectors. PRETTY. Lond. *Elec.*, Feb. 19.—The beginning of a well illustrated article in which he gives a description accompanied by good illustrations, of the Siemens and the Schuckert lamps for projectors; in both, parabolic reflectors made of glass silvered on one side are used, as such reflectors are cheaper than the Mangin mirrors; in the Siemens lamp the carbons are slightly inclined to the vertical and are a little out of line so that the light from the crater may pass unobstructed to the mirror, while in the Schuckert lamp both carbons are horizontal in the axis of the mirror; the mechanisms of both are illustrated.

Lighting of Public Building. HANDCOCK and DYKES. Lond. *Elec. Eng.*, Feb. 19.—A short article of a general character giving hints as to the methods which should be used and the conclusions to which many have arrived, regarding the best systems.

Search Lights.—Elec. Eng., Feb. 24.—A number of illustrations of the lightest types of those made by the General Electric Company, which are claimed to be equal, if not superior, to those which have been heretofore imported; they use the horizontal as well as the slightly inclined vertical carbons, and both the Mangin and the parabolic reflectors.

Faults in Arc Lamps.—Amer. Elec., Feb.—The various types of series arc lamp mechanisms are described, the faults to which they are subject enumerated, and remedies for the same given.

POWER.

Cost of Operating Electric Motors.—Elek. Anz., Feb. 11.—An extract from a recent report of the station at Dortmund giving some tabulated information about the power, running time, and cost of operation of a number of electric motors in different cities.

Large Water Power Scheme.—Eng. News, Feb. 25.—A note stating that a scheme is projected for Southern California, to utilize the power in the Santa Ana River; a ditch is to carry it four miles, thereby securing a fall of over 1000 feet; the power is to be transmitted at 30,000 volts to Los Angeles, seventy-five miles distant, thus making it the longest transmission at the highest voltage in the world; the work is to be begun about April first, and power is to be delivered by the first of January.

Power Plant at the Armour Institute.—West. Elec., Feb. 27.—An illustrated article describing the reconstructed and enlarged power and generating plant in this institution.

TRACTION.

Accumulator and Trolley Traction. KORDA. *L'Eclairage Elec.*, Feb. 6.—A reprint of a short paper read before the International Society, in

which he gives brief descriptions of the installations at Zurich, Remscheid, Hanover and Dresden (see another description in the *Digest* January 23), in which both accumulators and the trolley system are used together. He concludes that this mixed system has a real value in large cities, but only when the grades are not very great.

Overhead Electric Railway in London.—Lond. *Elec.*, Feb. 19.—A note stating that a bill is before Parliament to provide for the construction of the West Suburban Railway, 4.5 miles long, from Paddington to Willisden, which is to be an overhead electric line of ordinary gauge.

Mechanical Traction in Paris.—Bul. Soc. Int. des. Elec., Jan.—A reprint in full of the very long discussion of the recent paper, noticed in the *Digest*, Feb. 13; the discussion occupied the time of two meetings, and is chiefly of a local interest only.

Protection of Telegraph Lines Against Traction Currents.—Elek. Zeit., Feb. 18.—A reprint of the general rules and regulations issued by the German Government to protect the government telegraph and telephone lines against the currents used in electric traction, which rules should be considered in the construction of such railways.

Electric Vehicles. Krieger system. *Bul. Soc. Int. des. Elec.*, Jan.—A reprint in full of his short description noticed in the *Digest*, Feb. 13; see also Feb. 20.

Jungfrau Railroad.—Elek. Zeit., Feb. 18.—A reprint of the article noticed in the *Digest*, Feb. 20.

Electricity for Towing Canal Barges.—Lond. *Elec. Rev.*, Feb. 19.—A translation in abstract of the article noticed in the *Digest*, Feb. 20.

Pairing of Electric Railway Motors.—Amer. Elec., Feb.—It is recommended that electric railway motors which are to work in pairs should be tested before assembling for the reason that if there is any notable difference between the two motors of a pair, they will not work in unison; the tendency of one motor to drive the other as a dynamo will cause the load to divide unevenly, its full mechanical power will not be realized, while the overloaded motor will suffer from such treatment. A practical method is given for making the necessary tests when the motors are received by a road. It is pointed out that while it is possible to connect dynamos with different characteristics to the same bus bars and operate them satisfactorily, the case is different with series street railway motors, which must operate in parallel under every conceivable strength of field, from a positive to a negative maximum, and must regulate their own fields over this wide range.

Discharge of Electric Railway Circuits. Mountain. *Amer. Elec.*, Feb.—It is suggested that in order to protect the fields of electric railway motors from injury, in cases when the station circuit breaker is opened, due provision should be made for absorbing the energy in the trolley circuit; one of the means suggested is the use of a circuit breaker with carbon followers to maintain an arc between the carbon contacts for a time sufficient to discharge the circuit.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity Supply at 230 Volts. Gibbings. Lond. *Elec. Rev.*, Feb. 19, reprinted in *El'ty* (N. Y.), Feb. 24.—The conclusion of his paper, the first part of which was noticed in the *Digest* last week. He continues giving his experience at the Bradford station; there were on the circuit seventy motors, of which about half had to be rewound for the higher voltage; a spare machine was loaned while the change was going on, which was about nine months; the opportunity was taken to improve the motors so that many of them are now better than they were before; the number of arc lamps was 433; the only serious and important task in connection with the entire change was the re-arrangement of these lamps, as four had to be connected in series instead of two; in the case of arc lamps, consumers using two lamps, the difficulty was met by substituting a five-ampere double carbon lamp for the ordinary ten-ampere single carbon lamp. The high voltage incandescent lamps now used have an efficiency of 3.6 watts per candle; to protect consumers from being imposed upon with cheap lamps, he advocated supplying the lamps free of charge; the results of tests of some of the high voltage lamps are given. The change over is described in detail; at present they are using a two-wire system at 230 volts, the middle wire being useless until the time of the light load in the Summer, when the change will be made as follows: The middle wire at the station and at the feeder ends will be connected together, and all consumers will be transferred from the coupled outer to the middle wire; this entails only the transference of the installation wires from one fuse-box to another; after they have all been transferred to the middle wire the coupled outer main will be disconnected and the three-wire system at 460 volts will then be established; it will then only remain to transfer a portion of the consumers to properly balance the system; the additional and third service cable, which it has been necessary to provide for this purpose, will not entirely end its usefulness at that time, as it will serve in the future for balancing the maximum demand.

Electric Lighting of the Avenue de l'Opera.—L'Eclairage Elec., Feb. 6.—An illustrated description of the system of arc lighting which was recently installed, and which is said to be the first application on a large scale of street arc lighting by means of alternating current; there are five circuits of five lamps each, the mains having a voltage of 220; an illustration of the lamp and its mechanism is also given.

Electric Lighting Statistics for Paris.—Elek. Zeit., Feb. 11.—An abstract of the tabular information noticed in the *Digest*, Nov. 14.

Improvised Central Station Service.—Amer. Elec., February.—A detailed account of the expedients adopted after the destruction of the station of the Newark, N. J., Electric Light & Power Company, in establishing a temporary light and power service. The station had served 2400 arc lights, 14,000 incandescents and motors of 300 horse-power. The day after the fire, the power service was re-established, and at night the more important city lamps were supplied with current. Before a week elapsed the entire service was re-established.

WIRES, WIRING AND CONDUITS.

Culvert for Bare Copper Mains.—Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Feb. 19.—An illustrated description of the new culvert to be used at Preston. It is made of sections of strong glazed stoneware two feet long, which is imbedded in Portland cement on stoneware cradles at the joints, every third section being provided with a recess for an insulator which is secured with pitch and is made of glazed vitrified stoneware; the copper strips are laid in the flat slots in the insulator.

Inductance of Alternating Current Lines.—Amer. Elec., Feb.—The principles of the inductance of alternating current lines are established on the basis of lines of force cutting in and out of a loop, and the following formula deduced for the inductive drop on a given line carrying alternating currents, in which E^1 is the inductive, E.M.F. in volts per thousand feet of wire, C the current in amperes, n the frequency and k a constant taken from a table given in the article:

$$E^1 = \frac{nc\,(.9575 + 8.82k)}{10{,}000}$$

In an example calcuated for two transmission lines each 5000 feet long and each having 7 per cent. ohmic drop, but one line using No. 0 wire and the other No. 8 wire, it is found that, with a frequency of 60, the total drop in the case of the former is increased from 7 to 10 per cent., and that of the latter only from 7 to 7.1 per cent. It is pointed out that the inductance of itself is actually decreased with increase of size of wire, the great inductive drop of large wires being due to the large currents which they carry; for very large currents, and therefore very large wires, the total drop would not be materially decreased if the ohmic resistance of the wire were practically zero; the drop due to inductance may, however, be decreased to any desired extent by sub-dividing the wires, in which case the drop will be reduced to that of the smaller wire, and thus can usually be made negligible.

Alternating Current Wiring. Hanchett. *Amer. Elec.*, Feb.—The cause of the increase of drop in circuits carrying alternating currents is explained, and curves are given for the calculation of alternating current wiring; one curve is for 7200 alternations per minute and the other for 15,000 alternations per minute, both applying to wires ranging from No. 8 B. & S. to No. 0000; it is stated that the effect of the capacity in decreasing the drop is negligible except in the case of concentric conductors.

Saving of Copper in Three-phase Transmission Lines.—Amer. Elec., Feb.—A graphical method for determining the saving of copper in a three-phased system; an examination of sine curves laid down in proper phase relation, and representing the several line currents, shows that in a three-phase system each of the three wires alternately acts as a return or a lead for the two other wires; a comparison then made with a single phase system shows that the three wires on a three-phase system correspond to two circuits, in parallel, of a single phase system, or the three wires in the one will transmit the same energy with the same line loss as four wires of the same size in the other, thus making a saving in copper of 25 per cent. in a three-phase system. It is shown that for the same E.M.F. the maximum insulation strain in the three-phase and single phase systems is the same, but the superior copper economy above referred to also applies when a maximum insulation strain is considered.

Inconsistencies in Electric Wiring. Gardner. *Elec. Eng.*, Feb. 24.—An article calling attention to a number of inconsistencies in wiring as practiced to-day, and showing that often the lack of some minor detail counteracts the care bestowed on all the other parts; rules are followed in many cases with the utmost care, but in details about which the rules are silent, the work is often performed so as to cause more danger than by the non-observance of any rules. The rules make a great distinction between a wooden moulding and a wooden ceiling, each covered with varnish, but there seems to be no reason for it; gas nipples are often left protruding beyond the plaster considerably more than the threaded part; there are further inconsistencies in the putting up of fixtures; soldered joints are rarely insulated with tape to an extent equal to their original insulation; poor workmanship often counteracts whatever advantage conduits may have; the resistance of the metallic shell when used as a return circuit is often greater than that of the wire on the inside, and it will therefore heat with smaller currents than will heat the wire inside; the insurance inspectorship is indirectly responsible for one cause of poor workmanship, as many constructors will not engage a competent man to oversee the work, trusting entirely to the underwriters' inspection; a duty is required of this official for which he was never intended; engineers and architects should co-operate in making it impossible for any but reliable contractors to secure contracts.

ELECTRO-PHYSICS AND MAGNETISM.

Electric Resonance and Consonance. Feldman. *Elek. Zeit.*, Feb. 18.—The first part of an article which is to some extent a good summary and combination of published information on this subject, together with a comparatively simple, graphical and analytical discussion of some of the cases. If a coil having induction is connected in series with a condenser, and then to an alternating current source, and if the natural period of the circuit of the condenser and coil is equal to the period of the E.M.F. to which they are subjected, the current in the coil will be much greater than if there is no condenser and the charge in the condenser will be much greater than if there were no coil; this is a resonance phenomena; the general case of the approximate neutralization of inductance by capacity is according to Pupin (see The Electrical World Vol. 25, 1895, p. 168) called consonance. He then discusses the theory of

these phenomena, giving as an analogy a vibrating rod which is struck repeatedly by a hammer, and shows the different effects produced when the period of the repeated blows is in unison or otherwise with the natural vibration of the rod, resonance being effected when the two periods are equal. In the simple series arrangement above referred to, complete resonance can always be produced, but if the current is obtained from a transformer inserted between the source and the condenser and coil, complete resonance can never be obtained in the primary circuit, consonance then being produced; this he discusses graphically with the aid of a transformer diagram showing distinctly the difference between resonance and consonance; he then discusses it analytically; the article is to be concluded.

Rotation in Constant Electric Fields. QUINCKE. *Wied. Ann.*, page 417; abstracted briefly in the *Elek. Zeit.*, Feb. 11.—When non-conducting substances are suspended by cocoon threads between charged plates, and in an insulating liquid, they will rotate; he made very extended researches, the results of which are given briefly in the abstract; a sphere of aragonite, for instance, rotated 12 hours with an apparently constant velocity; certain spheres showed the same velocity of rotation in researches, differing in time by months and years; in air alone, even with very high voltages, no rotation was produced. He suggests that the cause is the action of the electric force on the layer of air surrounding the insulated body in the liquid.

Specific Resistance of Carbon-Zinc Alloys. HAAS. *L'Elec.*, Feb. 13.—A reprint in abstract from the German, of an article giving the results of measurements of twenty-eight chemically pure alloys of different proportions of copper and zinc; a curve showing the specific resistances is given, and another showing the temperature coefficients, both for alloys up to 50 per cent. of zinc; the first shows a maximum point and the second a minimum point for a proportion of 34 per cent. of zinc, which corresponds with the chemical formula and in which there are two atoms of copper to one of zinc, which corresponds to the chemical combinations; a similar result was obtained by others with alloys of copper and tin and with copper and antimony; a table gives the numerical values. The London *Engineering*, Feb. 12, contains a reprint of a report of the Alloys Research Committee of the Institution of Chemical Engineers, by Roberts-Austen, in which a number of curves are given showing various properties of copper and zinc alloys of various proportions from 1 to 100; some of these also show maximum points at about 30 per cent. of zinc.

Improvement in Röntgen Rays Tubes. BERLINGER. *Elek. Zeit.*, Feb. 11.—He describes an improvement which is based on preventing the change in the vacuum, as distinguished from reducing the vacuum by heat or other methods. While in action there is a strong electro-static charge developed on the walls of the tube; experiments have shown conclusively that there is a connection between this and the change of the vacuum; he explains this by stating that the charge on the walls attracts the molecules of the gas in the tube, thus increasing the vacuum; if, therefore, the charge is carried off, this cause of the change in the vacuum will be removed, and this, experiments have shown to be the case. He describes the suggestions of Porter and Fomm, neither of which, however, are quite satisfactory, the latter because injurious sparks are apt to be formed; this difficulty is overcome completely by blowing moist air against the tube, which, however, is not practical. Another way is to use points; a large number of needles were held by a wooden cylinder around the cylindrical end of the tube containing the cathode, and the result was surprisingly good; but it was also found that when the needles were removed and the wooden cylinder alone was used, the action was precisely the same, and the solution is, therefore, a very simple one, consisting merely in enclosing the end of the tube containing the cathode in a hollow wooden cylinder; the wood is too poor a conductor to give rise to sparking, and yet is a sufficiently good conductor to lead off the charge; it seems that the conductivity of the wood should be regulated by moisture; the tube can then be operated with appreciably lower voltages; any other poor conductor will answer, provided its conductivity may be regulated by moisture; to prevent it from becoming too dry, he suggests moistening it with glycerine, as this absorbs moisture from the air.

Photo-Electric Action of Cathode Rays. ELSTER and GEITEL. *Wied. Ann.*, 487; noticed briefly in the *Elek. Zeit.*, Feb. 11.—They repeated the experiments of Goldstein and found that the materials besides becoming colored, become photo-electrically sensitive; that is, they become incapable of holding a negative charge in air under the action of light; the cathode rays probably produce a reducing action on the materials.

Radiographs in Diagnosing Rheumatism and Gout. SERBANESCO. *L'Ind. Elec.*, Feb. 10.—An abstract of an Academy paper, in which he shows that different results are obtained in these two diseases, thus enabling radiographs to be used to distinguish between them; the appearance of the bones in the two cases are described.

Curious Skin Burn from Röntgen Rays. REID. Lond. *Elec. Eng.*, Feb. 19.—A note describing a curious effect occurring in a recent illustrated lecture by this professor of the University College, Dundee. He found that in obtaining a photograph of his own chest through the clothing, with an exposure of an hour to an hour and a half, the skin was not only affected on the side of the body toward the tube, as has been noticed by others, but that there was also a slight redness of the skin of the back over an area corresponding to that through which the rays passed out; thus the rays passed through the body without injury, but affected the skin where they entered and where they left the body.

New Röntgen Ray Lamp.—Lond. *Elec. Rev.*, Feb. 19.—A description of a new Siemens and Halske lamp in which the vacuum can be easily regulated; it appears that there is an additional anode in a small branch tube, the walls of which are covered with phosphorous or other air-absorbing material; when the vacuum becomes too low the positive pole of the coil is connected to this additional anode until the vacuum is sufficiently reduced; (experience with X-ray tubes seems to show that the pressure becomes less, the difficulty being to increase it rather than to diminish it.)

Röntgen Rays in Chemistry. HEMPTINNE. *Zeit. f. Elektrochemie*, Feb. 5; abstracted from the *Zeit. f. Phys. u. Chem.*, p. 498.—He experimented with the chemical action of Rontgen rays, and concludes that this action is only a very weak one.

Magnetism and Light. ZEEMAN. *Transactions of the Royal Academy of Amsterdam*, 1896; abstracted briefly in the Lond. *Elec. Rev.*, Feb. 19; a reference is given to the *Proc. Phys. Soc.*, Berlin, and to *Nature*, Feb. 11, 1896.—He recently discovered a curious influence which is exercised by a magnetic field on the period of light emitted by a flame; a sodium flame was placed between the poles of an electromagnet, and the light was examined with a grating; it was found that whenever the circuit was closed, both D lines were seen to widen; in another experiment sodium was heated strongly in a porcelain tube placed in a magnetic field and the absorption spectrum showed the same result; "it thus appears very probable that the period of sodium light is altered in a magnetic field"; he thinks the true explanation is given by the Lorenz theory of electrical phenomena.

An Experiment with the Magnetic Current. BRAUN. *Elek. Zeit.*, Feb. 11; abstracted briefly from a German physical paper.—A simple experiment may be made to show the analogy between the electric and the magnetic current; a spiral of iron wire is placed between the poles of a "Ruhmkorff electro-magnet," whose poles are as far apart as possible; a wire is inserted in the hole through the cores, and in the line of the axis of the iron coil, the ends of this wire being connected to a low-resistance galvanometer. When the magnet is excited the iron spiral will be traversed by a "magnetic current," which will excite an electric current in the axial wire; the direction of this current follows Ampere's law; when the iron spiral is removed, the excitation or cessation of the magnetism generates no current in that wire; if the spiral is wound in the opposite direction, the direction of the axial current will be reversed.

Deflection of Cathode Rays. BARR and PHILLIPS. Lond. *Elec.*, Feb. 19.—A short article supplementary to the one published on p. 289 of the *Electrical World*, Feb. 27. The changes observed in shadow contour when a current was passed through the anti-cathode, did not seem compatible with any magnetic effect, and they therefore concluded that the effects were due to differences of potential, the force being electrostatic instead of magnetic; experiments are described in which the shadows of a wire were observed, the wire extending through the tube, but broken by an air gap so that a difference of potential was established at the points forming the gap; when one of these wires was connected to the anode its shadow contracted, while that of the other wire expanded, the sides of the shadows remaining parallel; on connecting the other wire to earth the expansion of the shadow was so great as to fill the whole lower part of the tube. Another experiment is described in which a current passing through a plate in the path of the rays in the tube caused a translation in sense and direction of the current, of the green patch of light produced on the walls of the tube. Further experiments are to be made.

New Method of Operating an Induction Coil from Lighting Circuits. NORTON and LAWRENCE. *Science*, Feb. 26.—A short communication describing a new method which they used in order to be able to avail themselves of the current from an electric lighting circuit. A break which will work satisfactorily at this voltage, they claim, is yet to be supplied; they use instead a condenser of considerable capacity, connecting it first to the lighting main at 220 volts; it is then disconnected and discharged through the primary; this repeated and rapid charging and discharging of the condensers is effected by means of a commutator; the only current passing through the coil is from the condenser. A six-inch Ritchie coil connected in this way with a condenser of 25 microfarads, its own condenser being disconnected, gives a thick spark about two inches long; by changing the primary to one which presumably had less turns of thicker wire, a multitude of fine sparks about six inches long was obtained with the identical appearance of the sparks when the coil was worked in the usual way under the best conditions. The introduction of iron, unless finely laminated, cuts down the discharge to about one-tenth; increasing the speed of the charge and discharge up to about 2000 per minute, which is the maximum that could be reached with their crude apparatus, improved the discharge in quantity and voltage; the sparking on the commutator is very slight and the amount of power taken from the mains is small; tubes so driven give a brilliant fluorescence and produce strong, sharp shadows.

X-Ray Observations. PECKHAM. *Elec. Eng.*, Feb. 24.—He describes briefly some experiments to test the statement made recently that Rontgen rays will produce a glow in all kinds of vacuum tubes. A tube was enclosed in a light-tight box and a large number of tubes, both Geissler and Crooke's, were held outside of the box, some of which failed to glow, while others glowed at both ends and sides of the box; thick metallic plates between the tubes and the box did not diminish the effect, although they stopped the glow on the fluorescent screen; he therefore concludes that the glow is produced by electrostatic induction and is therefore not hindered by any metal or insulator which is interposed. He questions whether the supposed effect of X-rays on the skin and hair are really due to those rays or to electricity directly.

Lenard Rays. E. P. THOMPSON. *Elec. Rev.*, Mar. 3.—A short article calling attention to a recent letter from Lenard. One of Lenard's remarks seems to indicate that he does not agree in all points with Rontgen; he does not think the electric discharge action at great distances from the window of his tube is due to Rontgen rays, as these are only present in minute traces; there is another explanation, which is that the air is made conducting by the rays near the window, extending to parts further off.

Radiograph.—Elec. Rev., Mar. 3.—A reproduction of the radiograph of an arm with three hands, two of which are to be amputated, the object of the radiograph being to find how the amputation should be made.

Time of X-Ray Exposure. Willyoung. *Elec. Rev.*, Mar. 3.—A few remarks on the time of exposure required.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity in Chemical and Metallurgical Industries. Kershaw. Lond. *Elec.*, Feb. 19.—A continuation of his serial (see *Digest*, last week). He discusses the subject of chlorates of potash and soda; the first patent containing all the essential points of the more recent ones was obtained by Watt in 1851; the first industrial application was in 1889, and the results were so successful that the expansion has been rapid, and there are now nine plants in operation which are estimated to produce from 2000 to 3000 tons of potassium chlorate annually, the world's production of this material being estimated at 8000 to 10,000 tons; a table is given containing the names of the nine companies and some few of the details that have been ascertainable; four processes are used differing in details of the cell construction. The general principles of the processes is that the production of chlorate depends upon the secondary reactions in the ordinary electrolysis of the chlorides; the reaction occurs only in hot solutions, the heat being generally obtained from the current itself; there are two advantages, one is the distribution of the current by other salts than the potassium chloride present in the cell, and the other is the evolution of hydrogen at the cathode which reduces the chlorate again; there is much room for improvement. The Gall and Montlaur, the Blumenberg (used at Niagara) and the Franchot and Gibbs processes are briefly described; an estimate is made in a table, of the current and energy efficiencies, but it is limited to one of the processes, as the information was not available for the others; the current efficiency in this process (the Gall and Montlaur) was 35 per cent. and the energy efficiency 17.9 per cent., this being based on the annual output; Lunge's figures for the same process are 45 and 22.7; a saving of energy would result if some external source of heat could be used in place of the current and if the polarization due to the liberation of hydrogen could be prevented. The cost is thought to be lower than by the ordinary chemical process, but a cheap and large water-power is essential to profitable working; each ton of chlorate of potash per annum requires 3 to 3.5 indicated horse-power; if the energy costs 0.25 cents per electrical horse-power hour the expenditure of power will amount to upwards of 40 and 50 per cent. of the total cost of the manufacture; at Niagara this item is reduced to 29 per cent.

Production and Application of Ozone. Andreoli. *L'Elec.*, Feb. 13.—The beginning of a reprint of a recent address before the Society of Industrial Chemists in London. It is general in character, discussing the subject from the standpoint of the industrial chemist; he limits himself to the subject of the generation of ozone on a commercial scale. It will probably soon be possible to produce 30 to 50 grams of ozone per horse-power hour, while it is hoped that 300, 400 or 450 may be obtained; 500 is about half of the theoretical limit, while at present 50 has never yet been exceeded; in this he limits himself to large apparatus and not to small tubes which may be operated under exceptionably favorable circumstances. In a brief history of ozonizing generators he shows that the chief obstacle to overcome in the industrial generation is the heat which is formed in the apparatus; heat destroys ozone, and the glass when hot gradually loses the properties of a dielectric; it is then apt to allow a spark to pass, which destroys it; the production of ozone when generated by passing air, between two bare metallic electrodes, is greater than when these electrodes are enclosed; that is, when they are not in direct contact with the air; he discusses the generation of ozone in air at the rate of 20,000 to 30,000 cu. m. of air per hour; it is necessary to dry and refrigerate the air which is to be electrified; the time of the passage of the air should be reduced as much as possible; that is, the distance between where it enters and where it leaves should be as short as possible; the nitrogen products which are formed are greater in amount as the contact of the air with the discharge is more prolonged. The article is to be continued.

Industrial Production of Ozone.—Lond. *Elec.*, Feb. 19.—A short article referring chiefly to the work which Andreoli is doing in his endeavor to improve existing apparatus and to discover the best means of manufacturing and handling large quantities of ozonized air. The question of using oxygen or air is discussed, attention being called to the dilution of the nitrogen and the effect of the nitrogen compounds produced; notwithstanding this, Andreoli has concluded that it is more advantageous to ozonize air than oxygen; his present apparatus is similar to that described before and consists of a multitude of metal points separated by glass plates, a sort of glow discharge taking place between the points; the yield was as high as 40 grams per electrical horse-power hour, as was confirmed by analysis by two eminent chemists; at the rate of two cents per horse-power hour eight grams of active oxygen may be obtained for two cents; this corresponds to bleaching powder at about $200 per ton instead of about $31, the present price, which shows that ozone can be profitably employed only in cases where it does not compete with the ordinary cheap oxidizing agents. The question arises as to what uses it may be found to fulfil; the record is one of disappointment; many applications have been suggested, but nothing seems to have been achieved, which is thought to be due in part to the reticence of manufacturers; the applications should be patiently worked out in the factory and not merely in the laboratory.

Two New Primary Batteries. Pauling. *Zeit. f. Elektrochemie*, Feb. 5.—In one of these he used two electrodes of carbon, one of them in a porous cup, which has been saturated with a concentrated solution of common salt and is filled with strong chlorine water; it is placed in a jar containing concentrated thio-sulphate of sodium; the E.M.F. is 0.64 volts; at the anode, which is the carbon outside of the cup, turbidity will be produced, which is due to free sulphur; the interesting observation is that this free sulphur is formed throughout the whole liquid outside of the porous cup. The second form of battery is adapted for strong continuous currents, is simple in construction, requires but little attention, and the cost of the materials consumed is very slight; he has had it in use for some time; the anode is of iron, the cathode of carbon and the electrolyte of concentrated chloride of iron; when current is generated the solution is decomposed into chlorine and ferrous chloride; the ferrous chloride formed is easily converted again into ferric chloride by passing chlorine gas through the liquid; the materials consumed are therefore only iron and chlorine; the internal resistance is very low, as there is no diaphragm necessary; there is no odor; the E.M.F. is 0.9 volts. A detailed illustrated form of this battery is given; the containing cells are made of iron and the liquid is made to pass through the series of cells; 900 watt-hours will cost only 6.25 cents, which is about one-fifteenth of the cost of the cheapest form of batteries now in use.

Electrical Purification of Sugar Juices.—Lond. *Elec.*, Feb. 19.—A translation of the summary of a debate at the recent International Congress of Applied Chemistry, noticed in the *Digest*, Dec. 5 and Sept. 5.

Potential Difference Between Metals and Electrolytes. Wiedeburg. *Zeit. f. Elektrochemie*, Feb. 5; abstracted from the *Wied. Ann.* 59, p. 742.—The article is theoretical in character.

Voltaic Batteries are Thermo-Electric. Asher. *Elec. Rev.*, Feb. 24.—A communication in which he suggests the theory that the action of Voltaic batteries is ascribable immediately to the heat generated by the chemical action in the battery; in accordance with this theory he proposes to use two plates of similar metals which will not be attacked by the acid; one of these plates should be heated by some external means while the other remains cool; he then expects to find a current by connecting the two plates. Should this theory be sustained by experiment he thinks the direct production of electricity from coal will have achieved considerable advancement.

Preparation of Metallic Hydroxides.—Am. Jour. of Sc., March.—A brief description of the recent experiments of Lorenz showing that the metallic hydroxides can be easily prepared by electrolysis.

Large Storage Battery.—Am. Jour. of Sc., March.—A note stating that Trowbridge has recently constructed a battery of 10,000 cells for the Jefferson Physical Laboratory; it gives a voltage of at least 20,000, with a current of 8 amperes; it is unable to light a Crooke's tube; the lowest voltage which will produce Rontgen rays appears to be 100,000 volts; the battery can be used with great success to charge Leyden jars in parallel and discharge them in series by means of a commutator driven by a small motor; an oscillatory discharge through a Crooke's tube appears to be prejudicial to the development of X-rays; the best results were obtained without a condenser in series with a Crooke's tube, which seems to show that electrostatic polarization is largely instrumental in the generation of X-rays.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Units. Weber. *Elek. Zeit.*, Feb. 18.—A long article in which he discusses the subject in general, and in particular with reference to the proposition at the recent Geneva Congress; the discussion is intended to make it easier to arrive at more definite conclusions and not to make such a decision more difficult. He objects to some of the statements of Blondel in his Geneva paper, in connection with the historical introduction, as the early work of a number of physicists was overlooked; he questions whether the analogy made with the photometric and the magnetic quantities is a good one and whether it will facilitate matters; he shows that the analogy is not a good one. The quantities which should be fixed by international agreement are six in number, for which he gives the German, French, English and Italian names. The first is the intensity of light or the luminous power; the second the flux of light, that is, the beam of light in a solid angle from a source in the form of a point; the quantity of light, that is, the product of the flux of light by the time during which it continues to exist; the illumination, that is, the sum of all light fluxes falling on a unit of surface; the intrinsic brilliancy or brightness which is the intensity per unit of area of the light; and finally a term which he calls in German "belichtung," which is the product of the illumination and the time, which is of use in connection with chemical processes. For such a system the only units required are a unit of light, a unit of length and a unit of time; for the first the Hefner lamp has been designated by the Geneva Congress to be the most practical; the question then arises whether the unit of length should be the centimeter or the meter and whether the unit of time should be the second or the hour; in the Geneva proposals, sometimes the one and sometimes the other were used; in a large table he gives both systems, which he calls the primary and the secondary, the former being based on the centimeter and the second, while the latter is based on the meter and the hour; this table gives the definitions, the names, symbols, dimensions and formulas for each of the units; the symbols differ from those proposed at Geneva in that both the e and the E are used for illumination and that the h and H are used for brightness; the small letters are used for large units in which the quantities to be measured have small numerical values, while the large letters are for the small units; he abandons the term lux and suggests instead the meter candle and candle per sq. cm., for which latter he proposes the name centimeter-square-candle. He then discusses which of these two systems would be the best in practice, as there are some objections to each; the unit of light and of flux of light are the same in both; in the mixed system proposed at Geneva there is a tendency to confuse the centimeter and the meter; the most rational solution of the difficulty is to use the centimeter-second system as a primary system, and the meter-second system when

it is understood that for practical measurements of light, intensity, flux, quantity of light and illumination the secondary system should be used, and for the intrinsic brilliancy the primary system in the case of self-luminous bodies, and the secondary system in the case of illuminated bodies.

Use of very Small Mirrors with Paraffine Lamp and Scale. HOFFERT. Lond. *Elec.* and *Elec. Eng.*, Feb. 19; an abstract of a Physical Society paper.—He prefers small rectangular strips of microscope cover glass, chosen smooth and plain; they are first silvered and then cut to about 8mm. by 1.5, being suspended with their longest side vertical; they are light and have less inertia than round mirrors of an equal aperture. A paraffine lamp placed with the flame edgewise to the mirror gives sufficient illumination; the image of the flame is focussed on the mirror by a lens midway between them; a scale is fixed on the screen between the lens and lamp, and the screen has a circular aperture just below the centre of the scale provided with a vertical cross-wire; an image of the wire is formed on the scale after reflection by the mirror. In the discussion Boys thought that there was nothing new in the method, as he had frequently used such mirrors; in selecting them the microscope cover glasses are dropped one by one on a table when their thickness can be judged from a note emitted; their flatness can be estimated by observing the reflection of an illuminated straight edge; special care must be taken not to distort the mirror in attaching it to the suspended system; if liquid shellac is used the distortion will certainly occur unless the attachment is made at a point near the top, using shellac as viscous as possible; if the source of light is a point he prefers using a lens to form an image of the source on the scale via the mirror; the cross-wire is stretched near to the lens on the side toward the mirror and is focussed on the scale by a plano-convex lens, fixed as near as possible to the mirror with its plain face toward the mirror, the light passing twice through this lens. Thompson pointed out that Hoffert had obtained his result with only one lens by properly choosing the position of the cross-wire.

New Method of Determining the Dielectric Constants of Solid Bodies. STARKE. *Zeit. f. Elektrochemie*, Feb. 5.—A brief abstract of a thesis. The solid body is inserted in a condenser having a liquid dielectric whose composition is altered until the insertion and withdrawal of the solid dielectric does not change the capacity of the condenser; its dielectric constant is then equal to that of the liquid dielectric, whose constant is easily measured. The advantages of this method are that it is independent of the geometric form of the solid body and only a small amount of material is required; there is no difficulty in obtaining an accuracy of 1 per cent. For the liquid he used a mixture of benzole, ether and "aethylenchlorid" (ethyle chloride?), with which bodies may be tested whose constant is between 2.2 and 11.3; it is important that the liquid and the solid dielectrics do not have different specific resistances; the constants of a number of substances are given in the abstract.

D'Arsonval Galvanometer. DUJON. *L'Elec.*, Feb. 13.—A discussion of a number of points which should be noticed in the use of this instrument; he limits himself to the form in which there is only one suspension wire and in which a mirror is used. He discusses the influence of changes of temperature when used with a shunt, and shows that the error is less as the resistance of the shunt is greater; the only rational solution of this difficulty is to make the shunt of the same copper as is used on the frame of the galvanometer, and to mount it so that it is equally affected by the temperature of the surrounding air. He discusses the suspension and the scale, stating in connection with the latter that it is preferable to have the divisions smaller than 1 mm.; he recommends making them 0.6 mm. In conclusion he gives some formulas for the multiplying power of the shunt when it is not a simple number.

Frequency Indicator. MEYER system. Lond. *Elec. Rev.*, Feb. 19.—A translation of the article noticed in the *Digest*, Feb. 20.

Insulation of Induction Coils. ELIHU THOMPSON. *Amer. Elec.*, Feb.—Referring to the difficulty of using solid paraffine for the insulation of induction coils, it is stated that the air-bubble porosity of the solid paraffine can be obviated by subjecting the mass to considerable pressure while cooling and solidifying, at the same time ensuring a very gradual cooling of the mass. In this case the receptacle should be filled with a hot liquid paraffine and plenty of time allowed for the escape of gas bubbles before cooling under pressure.

Improved Method of Making Condensers. TESLA system. *Elec. Rev.*, Mar. 3.—A reprint of a recent patent in which he describes a method for making condensers, coils, etc., for high potentials, when a solid dielectric is used. He discovered that the air in this dielectric was often the cause of failure; in the present method, which applies to dielectrics which may be made liquid by heat, the apparatus with the dielectric is inserted in an air-tight vessel in which a vacuum is produced while the material is melted; after it begins to solidify on cooling, air is admitted under pressure until the whole mass is solidified; very good results were secured with a vacuum of 29 inches and a subsequent pressure of 100 pounds, although much higher pressures are of advantage; the apparatus itself is illustrated and described.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Development of Telephony. WEST. *Elek. Zeit.*, Feb. 11.—The conclusion of his paper, the first part of which was noticed in the *Digest*, Feb. 27.—He describes briefly some of the underground systems and points out the importance of having several subscribers on one wire, the chief objection to which is that the calls are heard by all of them; he describes a system in which this is overcome, none but the desired subscriber hearing the call; it is accomplished by means of a relay, and the line cannot be used by any one while one of the other subscribers is using it. In conclusion he discusses the question of a method for graphically representing the vibrations of the microphone membrane. It is followed by a somewhat lengthy discussion in which, among other things, the question is brought up as to whether the limiting distance was increased three-fold when a single wire circuit was changed to a metallic circuit; West claimed that by means of converters a greater distance may be reached than without; it has been tried in some places, especially in Switzerland, where it was very successful.

Telephone Service Without a Calling Battery at the Subscriber's End. RITTER. *Elk. Zeit.*, Feb. 18.—The first part of a description with diagrams, of a new system in which the signals are all given automatically and without the use of a battery at the subscriber's end; it is applicable to single or metallic circuits, can be used in connection with the usual annunciator at the station, with single or double cords; either a direct or alternating current can be used for calling; the signals are given by removing or hanging up the telephone.

Sixty Years of Submarine Telegraphy. AYRTON. Lond. *Elec.*, Feb. 19.—A long abstract of a recent Imperial Institute lecture; it is briefly abstracted in the London *Elec. Eng.* and criticised in the Lond. *Elec. Rev.* Feb. 19.—He began with the experiment of Cooke just sixty years ago and the signing of the contract between Cooke and Wheatstone for the first telegraph line in England; he gives an entertaining historical account of the earlier work in this field limiting himself chiefly to that done in England; he gives Morse the credit of having first used a wire in water insulated with india-rubber, and Brett that for having been the first to deal with submarine telegraphy in a commercial way; the first message which was sent through a submarine cable was in 1851, Nov. 13, the cable being across the English Channel; the first message between England and America was on Aug. 5, 1858. A number of models were shown explaining the passage of signals through submarine cables and like phenomena.

Submarine Earthquakes. MILNE. Lond. *Elec. Rev.* and *Elec. Eng.*, Feb. 19.—A brief mention of a recent Royal Institution lecture which the former journal claims to have been the best which has ever been delivered at that institution. He showed the connection between earthquakes and the sudden interruptions of submarine cables; the majority of earthquakes appear to have their origin in the sea and are most frequent and severe where the transition from comparatively shallow water to great ocean depths is most rapid. He recommends establishing earthquake-observing stations, one about every thousand miles along each side of the Atlantic.

Railroad Signals.—Lond. *Elec. Eng.*, Feb. 19.—A reprint of the discussion of Hollins' recent paper, noticed in the *Digest*, Feb. 20.

Excursions of the Diaphragm of a Telephone. BARUS. *Am. Jour of Sc.*, March.—Some time ago he noticed the remarkable phenomenon that with a continually decreasing current in the telephone the sound was found to terminate abruptly; a definite interval of silence could be mapped out for gradually increasing currents on either side of zero, and the extent of this interval was five to fifteen times the interval of current within which a change of sound intensity is appreciable when the limits of the field are exceeded. In order to find a reason for this he applied the interference apparatus described in a recent paper (see *Digest* Feb. 6): the results of his observations are given; he finds that for faint but distinctly audible sounds in a telephone the excursions of the diaphragm must be small as compared with the wave length of sodium light; the excursions of the plate of a Bell telephone cannot in the case considered be greater than three times ten to the minus sixth power centimeters, and they are probably even below one-third of this. He also computes the increment of force operating on the plate and finds it to be 140 dynes, an unexpectedly large result, which is an explanation of the unexpectedly small excursions of the diaphragm.

The Cause of Change of Microphone Resistance. FESSENDEN. *Amer. Elec.*, February.—Some experiments are described, the results of which showed very plainly that the sole and only change of any importance in microphonic resistance was due to change of surface contact, and that neither pressure nor heating produced any very appreciable effects, though some very slight effects were observed; subsequent experiments showed that some other circumstances are of vital importance; for instance, the oxide formed by the substance used for the contact must be a gas or a conductor if satisfactory results are to be obtained in use.

American Telephone Practice. MILLER. *Amer. Elec.*, February.—A number of forms of battery transmitters are described. It is stated that in the development of the transmitter the tendency has been toward an increase of the number of points of variable resistance contact. The early instruments of Berliner, Blake and others were provided with a single form of electrodes; following these came the multiple-electrode type originated by Huges, and to-day the granular or comminuted type has proven its superiority over, and is rapidly replacing, all others.

Accumulators in Telegraphy. MONTPELLIER. *West Elec.*, Feb. 27.—A translation, with the numerous illustrations, of the article which was noticed in the *Digest*, Jan. 16 and Feb. 6, describing the new installation in Paris.

Telephone Situation. JONES. *Elec. Rev.*, Feb. 24.—The conclusion of the reprint of his recent paper, the first part of which was noticed in the *Digest*, Feb. 20; a reprint is also begun in *El'ty*, Feb. 24; the whole paper is reprinted in the *West. Elec.*, Feb. 27.

MISCELLANEOUS.

Cast Copper. BROWN. *Elec. Rev.*, Mar. 3.—An article in which he describes some recent tests of commercial tempered cast copper, rolled

copper and a new variety called MB cast copper, showing the great advantages of the latter over the other two. In order to be able to cast copper, some other material has heretofore always been mixed with it, and it is known that even half of one per cent. of alloy is enough to reduce the electrical conductivity to one-quarter of that of pure copper; the MB copper was found to be 99.85 per cent. pure, which was purer than the other two; surprisingly good results were obtained; this metal can be rolled, cast or forged, and has a remarkable elasticity; it will be manufactured under the supervision of Mr. Edison.

Aluminum Patents.—Eng. and Min. Jour., Feb. 27.—A reprint of the second of the three Bradley patents (see *Digest*, Feb. 27), that being the most important; an illustration with an abstract of the specifications is reproduced.

Artificial Production of Diamonds. Moissan. *Am. Jour. of Sc.*, March.—A brief abstract of his artice in the *Comptes Rendus*, p. 206, July, 1896.

Electric Furnace. Kuester and Dolezalek. *Zeit. f. Elektrochemie*, Feb. 5.—A description of a simple form of furnace for laboratory purposes, which can be constructed at very small cost. It is made from two blocks of burnt lime, the blocks being as homogeneous and free from cracks as possible; they are sawed so as to have two flat surfaces; the lower block is then bored out perpendicularly to the surface so as to fit closely the lower carbon rod which is introduced through the hole from below; the upper block is similarly bored part way with a hole as large as in the lower block and the rest with a smaller one into which fits closely the upper carbon, which is smaller in diameter than the lower; the lower carbon runs only half way through the block, leaving the rest of the hole as a receptacle for the molten material; the upper block also has a diagonal hole for the escape of the gas and another larger one for the introduction of the material to be fused; the blocks are then placed with their flat sides together, the lower forming the furnace proper, the upper the lid; it is best to fit some iron hoops around the blocks so as to keep them from cracking; when not in use it must be protected from moisture; the carbons are regulated by hand, using an ampere and volt meter as indicators; with 40 volts the furnace described will be able to run continuously with 60 amperes.

Rapidly Intermittent Current Generator for Therapeutic Substances. Du Rocher. *L'Elec.*, Feb. 13; a reprint of a recent Academy paper.—He describes a generator for producing rapidly intermittent currents in one direction, as distinguished from the alternating high frequency currents used by d'Arsonval. He uses a static machine with a spark gap interrupter and special forms of condensers; the number of interruptions can be made to vary from 1200 to 7000 per minute. The physical, physiological and therapeutic effects of these currents are given; they deorganize solid bodies, volatilize liquids and decompose gases; they penetrate much more deeply into the organs; very good results were obtained in the therapeutic effects especially in connection with the treatment of skin diseases.

Advanced Studies of Physical Science. Bose. Lond. *Elec.*, Feb. 19.—A reprint of a Society of Arts paper in which he offers suggestions by which, with a slight reorganization of the existing institutions, India could be made very prosperous, as the prosperity of any country depends in a great measure upon the spread of scientific education and the practical application of sciences.

Biographical—Lond. *Elec.* and *Elec. Rev.*, Feb. 19.—Anannouncement of the death of Dr. Timothee Rothen, the director of the International Telegraph Bureau at Berne; it is accompanied by a short biographical notice.

Atmosphere Electrically Measured. McTighe. *Elec. Rev.*, Feb. 24.—A short communication in which he suggests that the Weather Bureau should study atmospheric phenomena with the aid of electrical measuring and recording devices placed far enough above our terrestrial surface to form a more reliable basis for prognostication.

The Earth as a Conductor. Bell. *Amer. Elec.*, February.—The theory of the earth as a conductor is discussed, and the conclusion arrived at that the conductivity of the earth is so meagre that, except in the case of very high voltages or very minute currents, it is quite insignificant in practical affairs; in railway return circuits the earth return does much more harm than good; for power service the earth is useless as a return, and in telegraphy alone does it appear likely to serve a permanently useful purpose.

Water Tube Safety Boiler.

The accompanying illustrations represent longitudinal section and elevation views of the Philadelphia water tube safety boiler manufactured by the Philadelphia Engineering Works, Ltd., Philadelphia, Pa.

In a single setting, which is the smallest type of a complete boiler, there are two steam drums and two mud drums, as represented in the illustrations. These drums are joined by straight vertical tubes, and each set is surrounded by walls forming two square chambers, the combustion chamber being external to these walls, as indicated in Fig. 1. The gases from the combustion chamber pass through brick arches up the first set, over the centre wall, and down the rear set to the chimney.

The setting may be built with its side walls hard up to any wall or partition, and double, triple or any multiple setting can be built with common dividing walls as in return tubular practice. This method saves much space, at the same time reducing the outside radiating surface. It will be evident from this construction that none of the castings are subjected to heat or steam pressure.

The walls have heavy angle bars at each corner held firmly by through-bolts. In multiple settings these angles are replaced by tees at each dividing wall.

Connecting tubes join the two steam drums and the two mud drums, providing ample area for the strongest circulation possible, and for the

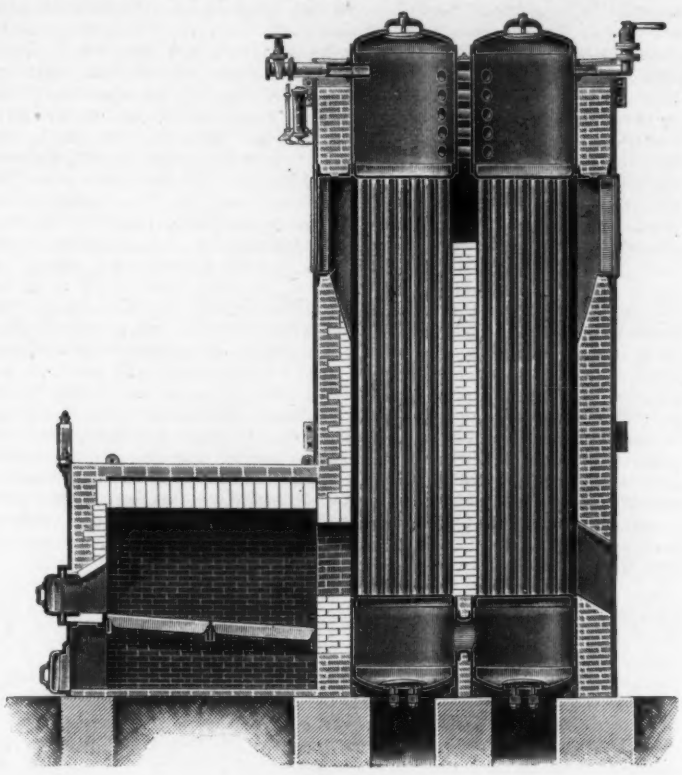


Fig. 1.

equalization of the steam pressure under all conditions. The vertical tubes are set in rows extending from front to rear, the space between the rows being greater than the outside diameter of the tubes. Opposite each space in the front and rear walls openings, closed with doors, are provided for the purpose of steam sweeping the tubes and through which the tubes may be passed when repairs are necessary.

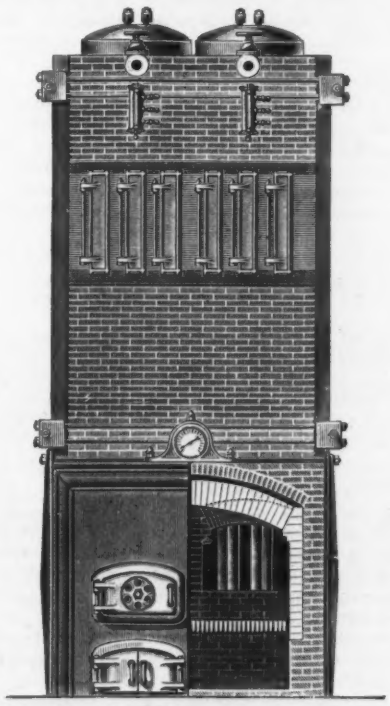


Fig. 2.

The Philadelphia Engineering Works manufactures two styles of these boilers—the standard and the low. As the gas current has to traverse double the length of the tube vertically, and the diameter of two drums horizontally, the tubes may be much shorter than common without reducing the gas traverse below that considered good practice. The standard style, or those with medium length of tube, are recommended for general service, for the reason that the cost is less for a given heating surface, but where headroom is limited the latter style is suitable.

The Company makes twenty sizes of these boilers varying from 60 to 260 horse-power in the following units: 60, 65, 71, 76, 82, 90, 98, 106, 120, 130, 138, 147, 152, 163, 180, 196, 211, 226, 240 and 260.

An Old and Well-Established Car Building Company.

The Barney & Smith Car Company, Dayton, Ohio, has one of the oldest and best-known car-building plants in the United States, having commenced business in 1849 on a small scale, and gradually increased in size and importance until the present time, when it has an immense plant covering some fifty acres, with large, commodious and substantial buildings. Its machinery is of the most modern design, and combined with every modern appliance, such as compressed air and electrical power, it has unsurpassed facilities for producing large numbers of cars rapidly, and, at the same time, in the most economical manner. It employs 1800 men, and keeps constantly in store 15,000,000 feet of lumber. Its daily capacity for turning out new work is one passenger car per day, five electric cars per day, and twenty freight cars per day. Its steam cars are to be found on every prominent line on the American continent, and its electric cars in most of the prominent cities in this country and many foreign lands.

The accompanying illustration represents one of the cars furnished by the Barney & Smith Company to the Mt. Clemens Fast Line, operating between Detroit and Mt. Clemens, Mich. These cars are built very much after the manner of steam coaches in detail of construction, and are mounted on the Barney & Smith Standard class "F" Interurban motor truck, which are too well known to need description in these columns.

One of the more recently equipped lines is the Dayton & Miamisburg Fast Line, operating twelve miles of road between Dayton and Miamisburg, Ohio. This road was equipped last Fall with Barney & Smith cars and trucks, similar to the one shown herewith, and at the present writing an extension of twenty-four miles additional track, to Middletown and Hamilton, is under construction, for which the Barney & Smith Car Company is now building the cars and trucks. These cars are executed in handsome design. The seats are of the Wheeler make, walkover pattern, upholstered in rattan. The windows are fitted with tapestry curtains mounted on spring rollers, with Burrowes automatic bottom fixtures. One feature of especial interest is an apartment set aside for the "smoking public," similar to the smoking compartments in the palace sleeping cars used by the steam railroads. This room is upholstered in leather, is well ventilated, and furnishes the smoker comfort and conveniences not found on other electric lines. The platforms of cars are large and commodious, being enclosed with vestibules and doors.

For high speed, interurban service, the Barney & Smith class "F" truck, shown under the car in the accompanying illustration, has demonstrated itself to be unsurpassed, having all the ease of motion and smooth riding qualities given by steam passenger car trucks.

For single truck cars the Barney & Smith class "G" truck is a type of motor truck lately brought out by this company. In addition to its riding qualities and economy of repairs, the point of merit in this truck is its adjustable end spring, by means of which car bodies of varying weights on the ends can always be carried level by means of these adjusting springs.

Some Recent Developments in Copper Manufacture.

BY HAROLD P. BROWN.

Some months ago in a new type of rail bond I used strips of rolled copper, with cast copper terminals. These castings were made for me by a firm which claimed extraordinary things for its product. I therefore expected very little from the metal, and in making tests was greatly surprised to find that a piece of this metal with but ⅜ of a square inch section could transmit 1500 amperes for twenty minutes without excessive heating. A calculation based on this performance indicated a conductivity of at least 90 per cent. that of the best rolled copper. As I had never before found cast copper with more than 40 per cent. conductivity, I decided to make a thorough and complete series of tests, so as to ascertain the facts concerning this metal, which is called MB copper. A chemical test suggested by Mr. Edison showed that these castings had less impurity than was contained in some sheet or rolled metal sold as pure electric copper.

To exactly determine the relative conductivity, I ordered a pattern made, from which I obtained castings of the best commercial copper and of the MB metal.

These castings were carefully finished, so as to present for testing a cylinder 25 inches long and 0.8 inches in diameter; a terminal was left at each end, about 2¼ in. x 2¼ in. x 1 in.

As a basis for comparison I had an exactly similar bar turned up from the best rolled Lake Superior copper. The completed bars were magnificent pieces of metal, without an apparent flaw. The difference in shrinkage of the two castings and a slight variation in the size of the terminals made it impossible to exactly obtain the comparative weight. The terminals of the rolled bar measured 2 in. x 2 7-16 in. x 1 in., and its weight was 7 lbs. 6 ozs.

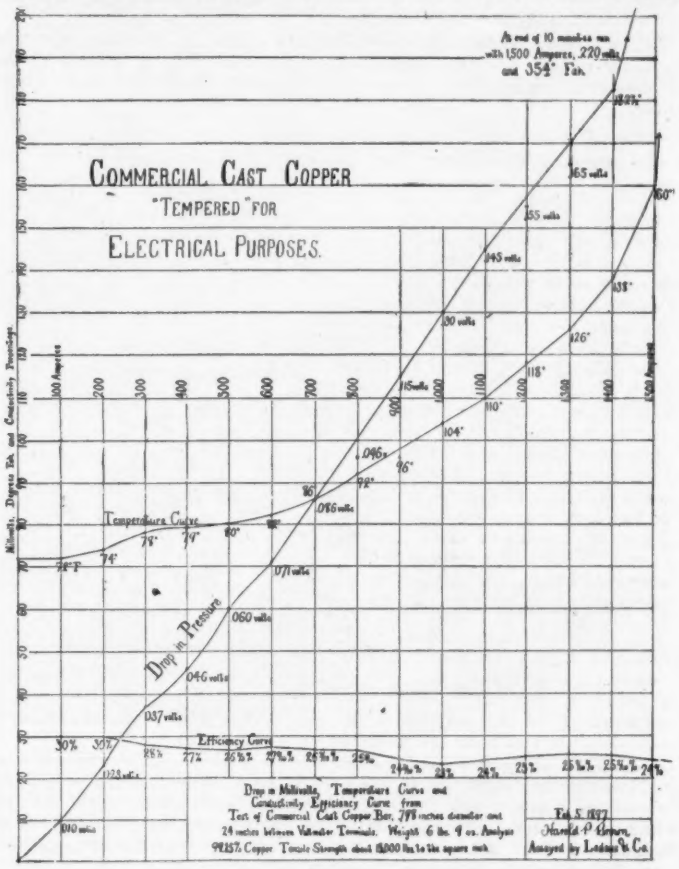
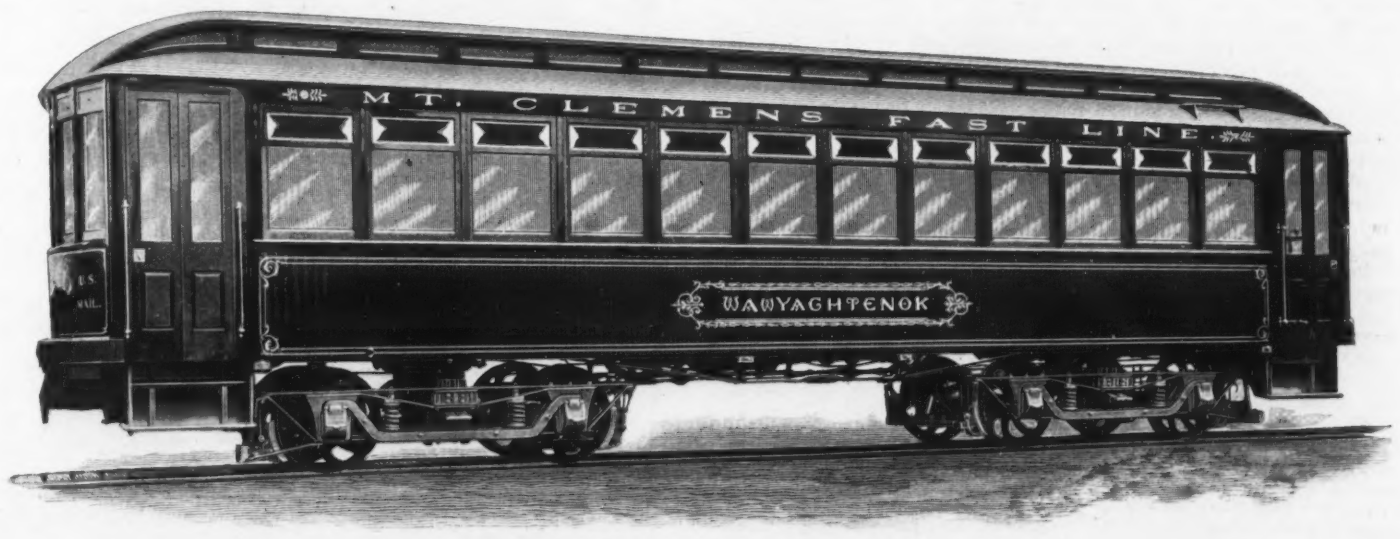

COMMERCIAL CAST COPPER
"TEMPERED" FOR
ELECTRICAL PURPOSES.
Temperature Curve
Drop in Pressure
Efficiency Curve
Drop in Millivolts, Temperature Curves and Conductivity Efficiency Curve from Test of Commercial Cast Copper Bar, 7/8 inches diameter and 24 inches between Voltmeter Terminals. Weight 6 lbs. 9 oz. Analysis 99.25% Copper. Tensile Strength about 15,000 lbs. to the square inch.
Feb. 5, 1897.
Harold P. Brown.
Assayed by Ledoux & Co.

FIG. 1.

The commercial cast bar was a popular process, "Tempered" copper, with terminals 2 1-16 in. x 2⅛ in. x 1 in.; its weight was 6 lbs. 9 ozs.

The MB bar's terminals measured 2 in. x 2 3-16 in. x 1 in., and its weight was 7 lbs. 1 oz. Each of the cast bars gave a clear, musical tone when suspended and struck; the MB bar, though the heavier, gave the higher tone. Of course, the rolled bar was without resonance. The commercial cast bar had accidentally been turned 0.002 of an inch too small, but the other two measured exactly 0.8 of an inch, thus having a section of practically one-half a square inch.



CAR FOR THE MT. CLEMENS FAST LINE.

I decided to test the electrical drop in two feet of each bar and its temperature at from 100 to 1500 amperes, the latter being three times the proper current for that section of copper. In order to prevent any rise of temperature from the contacts at terminals, each terminal was amalgamated by the Edison process and coated with the Edison flexible solder; there was, therefore, no appreciable drop at these contacts. In amalgamating the commercial copper bar by the Edison process fumes were given off with an odor of zinc, and a black precipitate was formed. This was washed off and the process repeated several times until the surface remained bright. Both of the other bars yielded instantly to the process without fumes or precipitate.

Mr. Edison states that this is a keen test of the purity of copper, and so it proved, for analyses subsequently made for me by Ledoux & Co. showed the commercial casting to have 99.15 per cent. of copper, the rolled bar 99.83 per cent., and the MB 99.85 per cent.

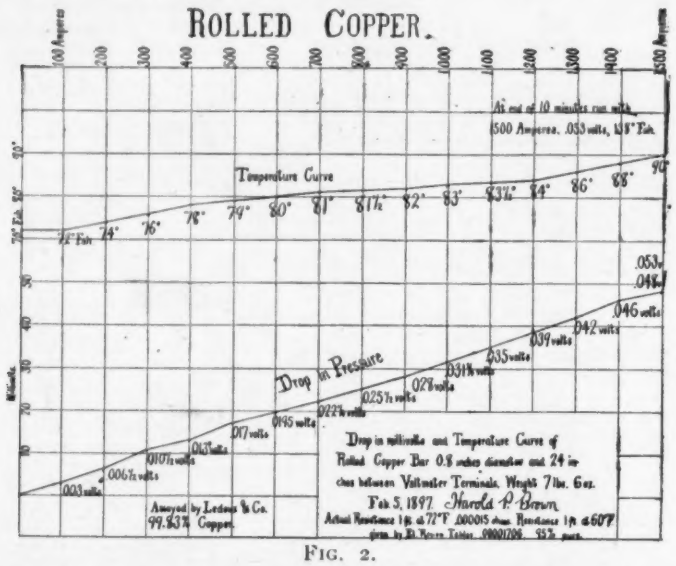

ROLLED COPPER.
Temperature Curve
Drop in Pressure
Drop in millivolts and Temperature Curve of Rolled Copper Bar 0.8 inches diameter and 24 inches between Voltmeter Terminals. Weight 7 lbs. 6 oz.
Feb 5, 1897 Harold P. Brown
Assayed by Ledoux & Co. 99.83% Copper.

Fig. 2.

In spite of the different characteristics of these bars, the variation in composition is less than seven-tenths of one per cent.

From tests of similar samples the tensile strength of the commercial cast copper was 19,000 lbs. to the square inch, while the MB was 30,000 lbs., which is practically the same as rolled copper.

The cables used for connections were 500,000 cm., with triple-braided insulation. When heavy currents were used the bare ends of the cables near the bar connections were cooled with wet waste.

The observed temperature of the bars was, therefore, not due to any outside cause. The instruments used were all made by Weston, and comprised a shunt ammeter reading to 1500 amperes, a millivoltmeter reading 0.0002 per degree up to 0.01 volts; another reading 0.002 per degree up to 0.1 volts, and a third reading 0.01 per degree up to 1.5 volts. In each case the same voltmeter terminals were used; these were clamped upon amalgamated spots on the bars just 24 inches apart.

A special dynamo, driven by Edison motors, was used; its field was excited from the Edison mains; by using a rheostat and a bank of lamps the amount of current generated could be accurately adjusted.

The first readings were taken at 100 amperes after about one minute's run; the current was then increased 100 amperes and a second reading taken, and so on until 1500 amperes was reached. This amount of current was continued for ten minutes, and increase of the temperature and drop noted. The bars were then disconnected and laid upon a wooden floor, and their rates of cooling noted. Since the copper resistance tables are either calculated for a constant temperature or were compiled years ago from data based on impure copper, I decided to use as a basis of comparison, the drop of the rolled copper bar at each 100 amperes. Since the performance of the MB copper came so close to this standard, I repeated the tests on each, and found the readings accurately recorded.

The tabulated results are as follows:

Amperes.	Rolled Copper.		MB Copper.			Com. "Tempered" Cast Copper.		
	Deg. F.	Mil. V.	Deg. F.	Mil.V.	Pr. Ct.	Deg. F.	Mil.V.	Pr. Ct.
100	72	.003	72	.0032	94	72	.010	30
200	74	.0065	72	.007	93	74	.023	30
300	76	.0105	72	.011	95	78	.037	28
400	78	.0134	72	.014	96	96	.046	27
500	79	.0017	72	.017	97	80	.060	26.6
600	80	.0195	72	.020	97.5	82	.071	27.4
700	81	.02225	72½	.023	96.7	86	.086	26.7
800	81½	.025	73	.027	94.4	92	.096	26.5
900	82	.028	73¼	.0295	95	96	.115	24.3
1000	83	.03175	73½	.034	93.4	104	.130	23
1100	83½	.035	74	.036	97	110	.145	24
1200	84	.039	76	.040	97.5	118	.155	25
1300	86	.042	78	.044	95	126	.165	25.4
1400	88	.046	80	.048	96	138	.1825	25.2
1500	90	.048	81	.052	92.3	150	.195	24.6
1500	138	.053	136	.057	93	354	.220	24

The last set of readings were taken after ten minutes' run with 1500 amperes.

The accompanying curves will show the behavior of the three metals under exactly the same set of conditions. The commercial cast copper averaged less than 28 per cent. conductivity, and before the end of the run scorched the wood on which it rested and the cotton covering the thermometer bulb, as it reached 354 degrees F. and 0.22 of a volt drop. Before the test the color of this piece was fine and closely resembled that of the other bars; after the test the bar was a mass of red and silver colored spots, and had lost nearly all its resonance. At the end of the run it had expanded from increase of temperature ⅛ of an inch in 24 inches, and 0.002 of an inch in diameter.

Allowance should be made for its difference in size. It required two hours and twenty minutes to cool the temperature of the room. The rolled copper showed a conductivity far greater than called for by the tables ordinarily used. Its actual resistance per foot at 72° F. was 0.000015 ohms. In the table published by the London *Electrical Review*, the resistance of a piece of copper 95 per cent. pure, one foot long, with a section of one-half a square inch, is said to be 0.00001706 at 60° F. Without reducing to the same temperature, the latter resistance is 13 7-10 per cent. greater than the resistance observed. The tables based on the Matthiessen standard conductivity also show greater resistance; it is, therefore, wise to use an actual measurement of modern rolled copper as a standard of resistance for cast copper. The rolled copper bar at the end of the ten minutes' run with 1500 amperes, reached 138° F. and 0.053 volts. It had then increased ⅛ of an inch in 24 inches, as did the other, but the diameter increased but 0.0005, instead of 0.002 of an inch. It required one hour and twenty-three minutes to cool. The performance of the MB copper was a surprise, and remains a puzzle. In the test it kept 8° to 10° cooler than the rolled bar up to a load of 1400 amperes. At the end of the ten minutes' run with 1500 amperes, it reached 136° F. and 0.056 volts. Its increase of size was the same as that of the rolled bar. It required one hour and thirty-nine minutes to cool.

The varying temperature of the two bars evidently accounts for the up and down movement of the efficiency curve, between 94 per cent. to 97½ per cent.

In another experiment I drove into an opening 19-16 inches wide, between heavy steel rails, a plug of MB copper cut in two pieces lengthwise, the sum of whose widths was 1 19-32 inches, thus compressing the metal 1-32 of an inch. A current of 1500 amperes was then passed through the junction, whose section was ⅜ of a square inch, and a drop of 0.018 volts was indicated from rail to rail through the two copper pieces in series. The rails were then separated 1-32 of an inch more, but the drop remained the same, showing that the copper had resumed

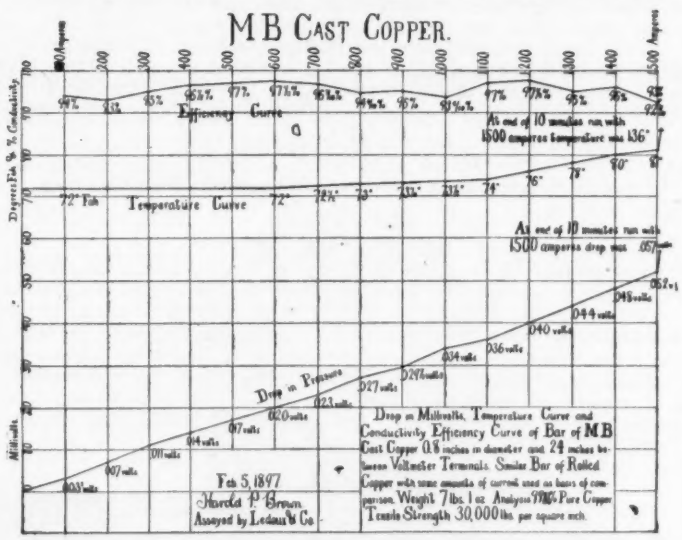

MB CAST COPPER.
Efficiency Curve
Temperature Curve
Drop in Pressure
Drop in Millivolts, Temperature Curve and Conductivity Efficiency Curve of Bar of MB Cast Copper 0.8 inches in diameter and 24 inches between Voltmeter Terminals. Similar Bar of Rolled Copper with same amounts of current used as basis of comparison. Weight 7 lbs. 1 oz. Analysis 99.85% Pure Copper. Tensile Strength 30,000 lbs. per square inch.
Feb 5, 1897
Harold P. Brown
Assayed by Ledoux & Co.

Fig. 3.

its previous width. An analysis of another sample of this MB copper gave the following results:

Copper	99.870 per cent.	Bismuth	None.
Silver	.034 per cent.	Lead	None.
Iron	.011 per cent.	Cobalt	Trace.
Arsenic	.002 per cent.	Sulphur	None.
Zinc	.013 per cent.	Oxygen (by difference)	.068 per ct.
Tin	None.		

This analysis is verified by others made by such experts as Ledoux & Co.; Booth, Garrett & Blair, Prof. Frank X. Moerk and others, and shows exactly the same results as the best Lake Superior copper. It is evident that no alloy has been used. And yet the process has increased the electrical conductivity and the tensile strength; has given a certain amount of elasticity and decided resonance; has increased the density and changed the structure of the metal.

On presenting this matter to Mr. Edison he accounted for the evident change in the structure of the metal by the theory that the shape of the crystals had been altered so that their lines were parallel, and that the molecules were thus brought closer together and into more intimate contact with each other.

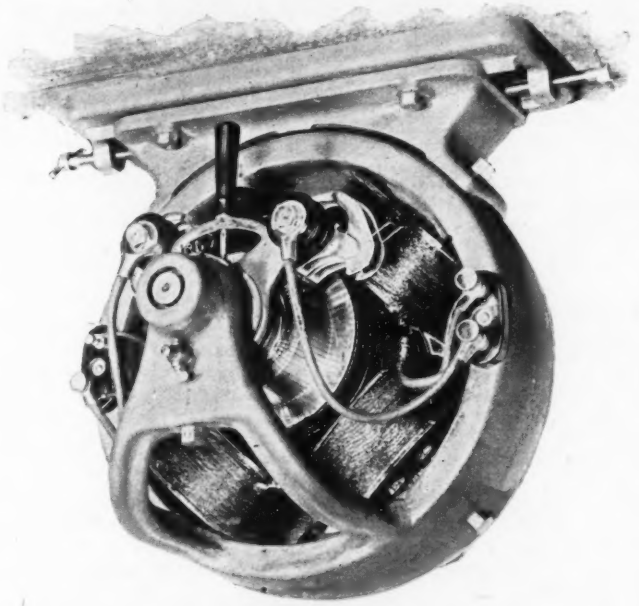
The fact that MB copper can also be rolled or forged adds new interest to its development. As its tensile strength exceeds that of ordinary copper wire, it is certainly worth while to make wire from it in order to determine its strength and conductivity.

It is understood that Mr. Edison is interested in the development of the process, and that the MB copper will be manufactured under his supervision at the celebrated Menlo Park works.

A New Ceiling Motor.

The electrical distribution of power in factories and the operation of individual machines by electric motors in situations where floor space is valuable, has resulted in a growing demand for ceiling motors. These can be bolted to the ordinary joists or the ceiling timbers of a mill, and if designed for low speed can be directly connected to a line shaft.

To meet this demand the Ahlm-Edwards Electric Company, Medina, Ohio, have introduced the four-pole type of ceiling motor here illustrated. The design of this machine shows a careful proportioning of the various parts to the duties they perform, and has resulted in a very compact, simple and efficient motor. The cast-iron ring frame, of ample proportions, supports four cast steel magnet cores. These are especially designed to distribute the magnetic flux symmetrically and evenly, and to preserve the balance of field which results in sparkless running.



5-HP MOTOR.

The armature is built of unusually thin discs, japanned before assembling and slotted very carefully to obviate filing or milling, with consequent burring, after the discs are in place. The winding is of interchangeable machine-wound coils, which insures both electrical and mechanical balance, and is carefully insulated by hand before being placed in position on the core.

The commutator contains an unusually large number of segments and very large brush surface. It is built up of drop forged copper bars, with mica insulation, strongly keyed together and having interchangeable parts built to gauge. Radial brush holders and carbon brushes are used, and all bushings and washers are of hard rubber.

The adjustable base supplied with this machine permits its attachment to either ceiling, walls, or floor, and adds greatly to the convenience of its installation, especially in crowded situations.

The symmetrical design and balance of these machines ensures noiseless and sparkless operation under all ordinary conditions, while their compactness enhances both their strength and appearance.

The Sioux City Corliss Engines.

About a year ago the Murray Iron Works Company, Burlington, Iowa, bought out the plant and business of the Sioux City Engine Works and moved it to Burlington. There it erected, last Summer, near its old plant, a new machine shop exclusively devoted to the building of Corliss engines. The Sioux City engine had already an enviable record for

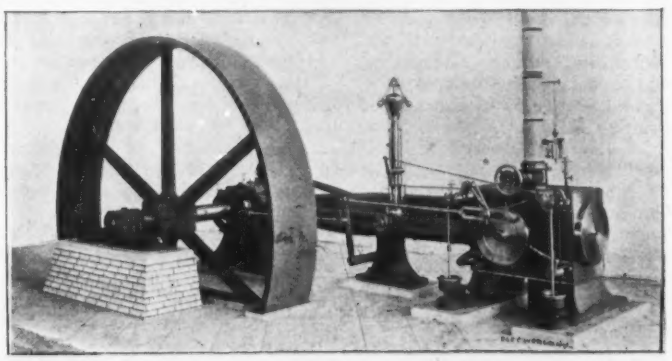


FIG. 1.—CORLISS ENGINE.

economy, regulation and durability, and its merits were recognized by a medal and diploma at the World's Fair. In the hands of its new builders it has been improved wherever it was felt that improvement was necessary, and now possesses several features of great merit.

The two illustrations, Fig. 1, showing the smaller size of engine, and Fig. 2, showing the valve motion, dashpot arrangement and disconnecting device on a larger scale, clearly indicate the chief points of the design. The high-speed governor, running on ball bearings, is an ad-

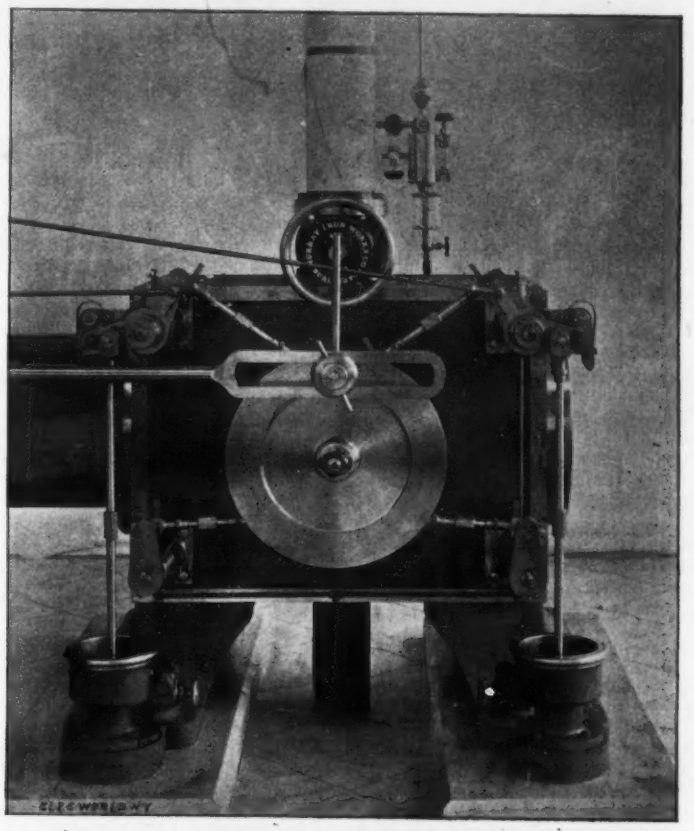


FIG. 2.—CORLISS ENGINE.

mirable device and secures quick regulation. The valves, both steam and exhaust, have been changed in form and improved, and the exhaust passages are insulated from the cylinder by dead air spaces. The outer pillow block is vertically adjustable, which will be found a feature of great convenience. The Murray Iron Works Company has been so long and well known as a builder of engines that it is quite certain this new type will meet with the favorable reception which it deserves.

A New Telephone Desk Set.

Among the numerous telephone specialties manufactured by Messrs. Taber & Mayer, Boston, Mass., is the desk set illustrated herewith. The height of the set is eleven inches, while the base occupies only five inches of desk room. A low resistance, granular carbon type of trans-

DESK TELEPHONE.

mitter is used, adapted to stand a strong battery current. In it are two diaphragms, a feature covered by patents which is intended to utilize the greatest possible number of sound waves. The volume and distinctness of speech are surprising.

The set is finished in nickel trimmings and has a hard rubber base, watchcase receiver, buzzer and push button. A four-conduction silk-covered cord, three feet long, permits the free handling of the set and allows it to be placed in any convenient position on the desk.

Incandescent Electric Lamps.

Considerable interest has been manifested in the incandescent lamp situation as affected by patents owned by the Westinghouse Electric & Manufacturing Company. In order to advise our readers of the exact status of affairs, we have obtained the following information from the officials of the Sawyer-Man Electric Company, which company conducts the incandescent lamp business for the Westinghouse Company.

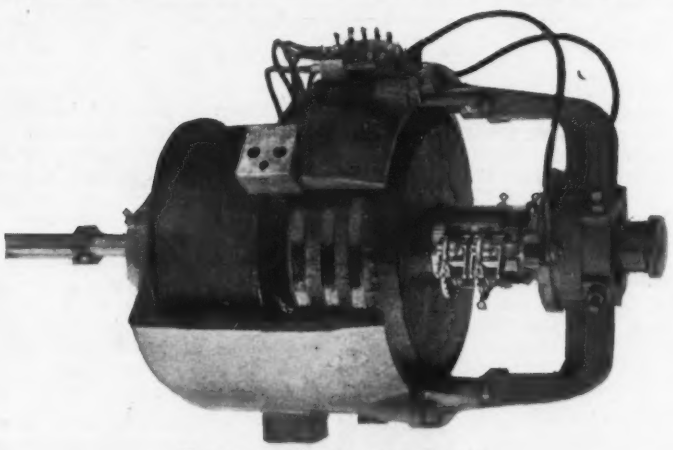
The Westinghouse Company is the owner of a large number of patents relating to incandescent lamps and the processes of manufacturing of the same.

The following companies have been granted licenses by the Westinghouse Company, and are now operating under these patents, viz: Byran-Marsh Company, New York City; The Perkins Electric Switch Manufacturing Company, Hartford, Conn.; The Columbia Incandescent Lamp Company, St. Louis, Mo.; The Buckeye Electric Company, Cleveland, Ohio; The Sunbeam Incandescent Lamp Company, Chicago, Ill.; The Adams-Bagnall Electric Company, Cleveland, Ohio; General Electric Company, Harrison, N. J.; New York & Ohio Company, Warren, Ohio.

It is further understood that the Westinghouse Company is prepared to grant licenses upon equitable terms to other reputable manufacturers of incandescent lamps, and that several are now negotiating for them. Newspaper statements have appeared from time to time to the effect that a pool has been formed among certain lamp manufacturers. The officials of both the Westinghouse and Sawyer-Man Companies state that they are not members of any such pool, but are continuing the independent manufacture and sale of incandescent electric lamps. Other rumors, to the effect that the Westinghouse Company has gone entirely out of the incandescent lamp business, are denied by the officials. This rumor may have arisen from the fact that the Westinghouse Company does not itself manufacture incandescent lamps, having, about a year ago, reorganized the Sawyer-Man Company, one of its controlled companies, and transferred its incandescent lamp business to that company.

Special Boat Motor.

The use of electric motors to operate all classes of mechanical apparatus has, in many instances, required special designs, particularly when space, weight and speed must be reduced to a minimum. The motor here illustrated, manufactured by the C & C Electric Company, 143 Liberty Street, New York City, was specially designed as a torpedo or electric launch motor, but it also readily lends itself, when mounted on a suitable base, or directly fastened to the machine to be operated, to a variety of other uses. The peculiar shape and compactness of the motor are notable features. The field-magnet is energized by a single coil wound on the core of the magnet, which is placed concentric to the armature shaft. The pole pieces are fastened to the ends of the core and brought to one side of the coil, leaving a space between their polar surfaces equivalent to the diameter of the coil spool. The armature revolves between these pole pieces, one end of the shaft projecting concentrically through the field core, being supported in a bearing at the outer end, the commutator end being supported in a bearing held by two



Electric Motor for Boats.

arms fastened to the outer edge of the pole pieces. This peculiar construction gives the machine a cylindrical shape, with a diameter of cylinder scarcely more than that of the armature.

The motor is entirely self contained, and can be fastened at the points shown or at the end of the field core, to any base or machine. The general make-up of the motor is of the well-known C & C standard. The magnetic circuit is extremely short, and the commutation is practically sparkless. These machines are built to operate at any commercial speed, the large armature particularly lending itself to slow speeds. The weight of these machines is reduced to a minimum consistent with efficient operation. Only the smaller sizes are manufactured at present.

Lamp Cord Adjuster.

An efficient incandescent lamp cord adjuster is illustrated herewith. This device can be attached with facility, and as it is low in price it meets with considerable favor.

This adjuster possesses some points of excellence which commend it to all who have occasion to use a device of this character. It can be instantly adjusted to any position within its range, the cord being held firmly without the slightest wear or tear. It can be placed in position readily, without the necessity of having to detach the cord from the lamp socket or rosette, in this way saving time and annoyance.

In construction it is both light and compact, and is guaranteed to meet every claim made for it.

Lamp Cord Adjuster.

This adjuster is handled by the new electrical house of William Murdock & Co., 160 Congress Street, Boston, Mass., who are general agents for the same.

The Bullock Electric Manufacturing Company.

The Card Electric Motor & Dynamo Company, Cincinnati, O., has changed its name to The Bullock Electric Manufacturing Company. Mr. George Bullock, president of The Bullock Electric Manufacturing Company, and formerly of the Card Electric Motor & Dynamo Company, and Mr. Robert T. Lozier, formerly General Eastern Agent of the Card Electric Motor & Dynamo Company, have formed a partnership known as the Bullock Electric Company, to act as general sales agents for the Bullock Electric Manufacturing Company in the territory east of the eastern Ohio boundary and north of the northern boundary of Virginia and West Virginia.

The change in the old manufacturing organization is simply in name. As concerns the selling organization, while Mr. Lozier previously acted as the general Eastern agent for the Card Electric Motor & Dynamo Company, he and Mr. Bullock will now sell the apparatus on their own account. In addition to its regular selling organization, the Bullock Electric Company has added a well-organized engineering and construction force, so that it is well equipped to undertake complete installations, including the steam, as well as the electrical parts of power transmission and lighting plants.

It will be remembered that the Card Electric Motor & Dynamo Company has in the past been most active in developing the application of electric power in new lines. It has met with considerable success in newspaper work, which has been found one of the most difficult fields for the application of the electric motor in its fullest development. The Bullock Electric Manufacturing Company will carry on this work of special motor applications. Mr. Bullock has associated with him some of the best engineers in the country, and in addition to the special power applications, the Bullock Electric Manufacturing Company will continue its fully developed line of standard apparatus for both power and lighting service.

The Bullock Electric Manufacturing Company has, in addition to the New York, Boston and Philadelphia offices of the Bullock Electric Company, offices in Chicago, St. Louis, Louisville, Spokane, Atlanta, Denver and London, Eng.

The Bullock Electric Company has moved from the American Tract Society Building, at 150 Nassau Street, into roomy quarters in the new St. Paul Building, New York City.

Mr. George Bullock was graduated from Cornell University in 1883, after completing a course in mechanical and electrical engineering. Apart from his connection with the Card Electric Motor & Dynamo Company, he is well-known in electric street railway circles, having constructed, financed and managed several electric roads in and about Cincinnati, and is now largely interested in the Consolidated Traction Company of that city. His interest in electrical engineering led to his connection with the Card Electric Motor & Dynamo Company at the time of its conception some eight years ago, and within the last eighteen months he has taken an active interest in that Company until now it

is entirely within his control, and he has taken upon himself the management of its affairs.

Mr. Lozier, although one of the younger men, associated himself in 1883 with the Edison Electric Light Company, having acted as one of Mr. Edison's personal assistants in the office, factory and laboratory. At the time of the consolidation of the Edison and Thomson-Houston Companies interests in the formation of the General Electric Company, Mr. Lozier was made manager of the isolated lighting department of that Company, under Mr. S. Dana Greene, the general manager of the Lighting Department. Mr. Lozier's technical experience will be of great aid to him in his commercial work as managing partner of the Bullock Electric Company.

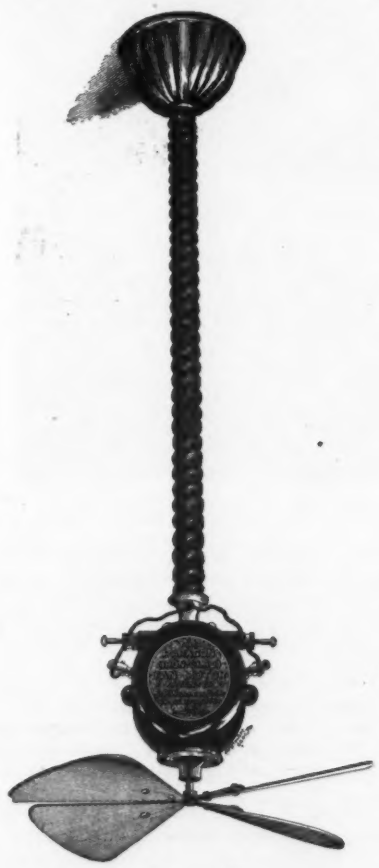
A Novel Electric Fan.

The approach of the warm season is heralded by the appearance of a number of designs of fan motors and other breeze-making devices, but few of them are designed with so much care and in such practical and simple form as those illustrated herewith.

The large ceiling fan, with its fifty-inch swing of blades, has become a very popular and much-appreciated device, but there are many situations in which such a fan is hampered by light fixtures, columns, etc., and cannot be installed. To meet this objection the new thirty-inch Paragon ceiling fan has been designed, the smaller swing of the blades being compensated by the higher speed of rotation—300 revolutions per minute. These fans are also made in the standard fifty-inch size, operating at the standard speed of 175 revolutions.

The features of the Paragon fan motors which arrest attention are their simplicity, compactness and efficiency, and the excellence of their mechanical construction. The armature is wound in deep radial slots, leaving narrow feathers of iron between. The careful lamination of the core prevents Foucault currents, and the iron-clad re-entrant field, wound with machine-made coils, secures the highest magnetic efficiency. The bearings are entirely exterior to the fields, and so made that their alignment is necessarily perfect. Grease cups are used for lubrication, and the position of the bearings and shaft-collars are such that it is impossible for the grease, or oil, if inadvertently used, to be thrown on the commutator or armature windings.

The commutator is made of heavy bars, having a broad bearing surface, insulated with mica, and thoroughly keyed together. The carbon



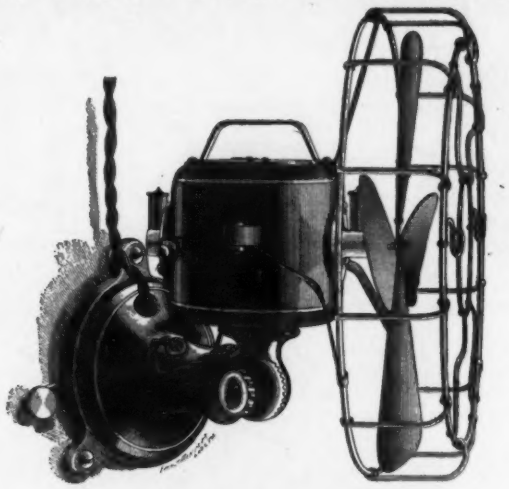
CEILING FAN.

brushes are flat, and bear over the whole surface of the commutator bars, insuring smoothness of running and even wear. The operation of the motor is practically noiseless, and no appreciable heat is developed even after a long run.

The desk fans, at full speed, consume only 55 watts, or 0.45 ampere at 115 volts.

These fan motors are made in a variety of styles. Besides those mentioned there are a variety of desk fans, having 12, 14 and 16 inch blades, and running at speeds from 1200 to 2200. These are made in the usual standard form, mounted on a universal joint and bracket for wall support, and suspended from a standard for ceiling use. They are uniformly provided with a porcelain base switch, giving two speeds.

A feature of these fans is the elaborate finish of the iron parts, which are treated to a coat of bicycle enamel, baked on. The standard color is bottle-green, but they are also finished in white, black, blue, maroon



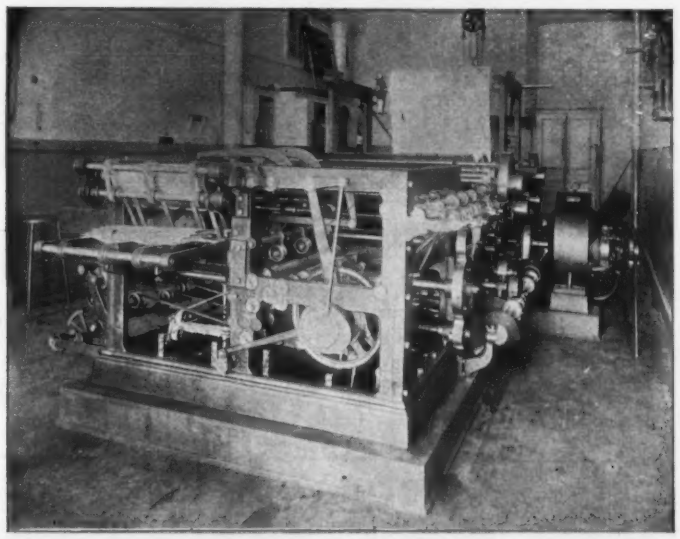
BRACKET-SUPPORTED FAN MOTOR.

and yellow, to correspond with the decoration of the rooms in which they are used.

Mr. J. P. Williams, 39 Cortlandt Street, New York, is the general agent for the Paragon fan motors.

Direct Connected Motors.

The advance in the adaptation of electric motors to meet the varied requirements of power transmission is most apparent at the present time along the lines of direct connected apparatus. Especially is this noticeable in running printing presses by electric motors, in which work the requirements are both varied and severe. The motor must develop an abnormal starting torque without the least jar; it must admit of great variation in speed by economical methods, and it must be compact and simple in construction so as to reduce to a minimum the lia-



PRINTING PRESS OPERATED BY ELECTRIC POWER.

bility of delay through accident. The requirements are especially severe in the case of the web type of press, as the great inertia to be overcome in starting must be accomplished without injuring the web.

The accompanying illustration shows a motor of this type direct connected to a Campbell web perfecting press. It has shown itself to possess in the very highest degree all of the qualities necessary to meet the requirements as stated above. It has a capacity of 20 horse-power and the speed adjustment can be varied at will from 180 to 280 revolutions per minute. Although the press requires from 50 to 100 per cent. more power to start it than to operate it, yet the motor is so carefully adjusted that the press is said to be put in motion without the least perceptible jar or strain. The advantage of this type of motor for operating individual machines is very great, allowing of placing the machine where most convenient without relation to source of power. The doing away of line shafting and belts, with their attendant dust and consumption of power makes the efficiency of the system very high.

This motor, which was manufactured by the Thresher Electric Company, Dayton, O., forms part of the electrical equipment of the United Brethren Publishing Company, Dayton, O. Over two years ago the latter concern's power plant was overhauled and a complete electrical equipment of the Thresher Electric Company's apparatus was installed, effecting a saving in the power developed over the former method of transmission of over 60 per cent.

Two Prominent Water Turbines.

Prominent among the great manufacturing plants found in the City of York, Pa., is that of the S. Morgan Smith Company, manufacturers of the new "Success" and "McCormick" turbines, power transmission machinery, etc.

The buildings, which are over 1100 feet in length, cover several acres of ground, and are constructed chiefly of stone and brick. The many railroad tracks, traveling cranes and elevators in use upon the premises and within the buildings are so placed that the articles of machinery, whether in their crude or finished state, and weighing as high as 60,000 pounds, are handled with great facility. The plant throughout is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers, and whatever else is needed in the construction of turbine water-wheels, iron flumes, shafting, pulleys, gearing, steam boilers, etc. Some of the pit lathes and boring mills turn off and bore out pulleys, rope sheaves and fly-wheels with as great diameter as 25 feet and 6 feet in width upon their face. There are also some remarkably large and fine machine tools for cutting and dressing gear-wheels up to 20 feet in diameter and as much as 30 inches on the face.

The Company is composed chiefly of father and three sons, all of them being hydraulic and mechanical engineers, as well as practical business men. This fact no doubt accounts for the conveniently and systematically arranged plant.

In the works an abundance of light is provided by day through large windows in the ceilings and walls, and at night the illumination is provided by arc and incandescent lights supplied by the Company's own generators.

A large amount of money has been spent in improving and scientifically testing the water-wheels built by this Company, and in this way it knows the speed and power of each size of its wheels so perfectly that, when informed as to what power is needed and the head of water available in any case, it claims never to make a mistake in the size and number of water-wheels required to operate the plant to the best advantage.

The accompanying illustrations represent some of the recent work turned out by this concern. In Fig. 1 is shown one pair and one single 21-inch McCormick turbines in iron cases on horizontal shafts. The shafts are connected by a friction-clutch, and the power is taken off at one end by a rope drive. These turbines operate under a head of 64 feet.

In Fig. 2 is represented a line of horizontal McCormick turbines consisting of one pair and one single 51-inch turbines in iron cases. These turbines are used in the mill of the John P. King Company, Augusta, Ga., and develop 2700 horse-power, which is taken off at one end of the shaft.

The McCormick wheel is the invention of Mr. John B. McCormick, who has spent over thirty years in designing and testing water-wheels. All sizes of wheels are built over patterns which have been tested under the dynamometer. These wheels are well built, very strong, and nicely finished.

It is said that more McCormick wheels have been tested in the Holyoke testing flume than those of any other make. The McCormick wheel is known as the cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate-operating device, thus regulating the flow of water to the runner. The gate is balanced and operates very easily, and the wheel is very steady in motion, and therefore especially adapted for driving electrical machinery.

The "McCormick" and new "Success" water-wheels and other machinery in which the S. Morgan Smith Company enjoys such an extensive trade give the best of satisfaction wherever they are used.

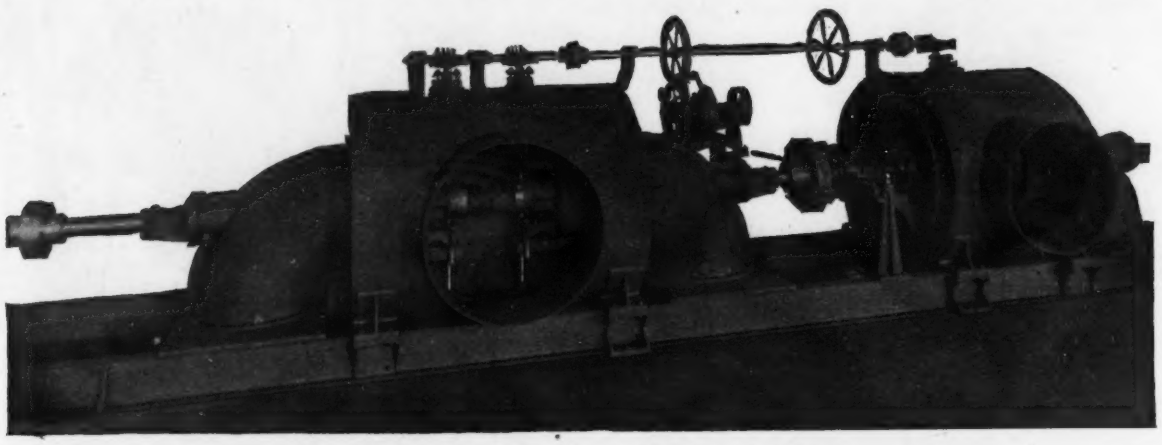


Fig. 1.—21-inch Turbines on Horizontal Shafts.

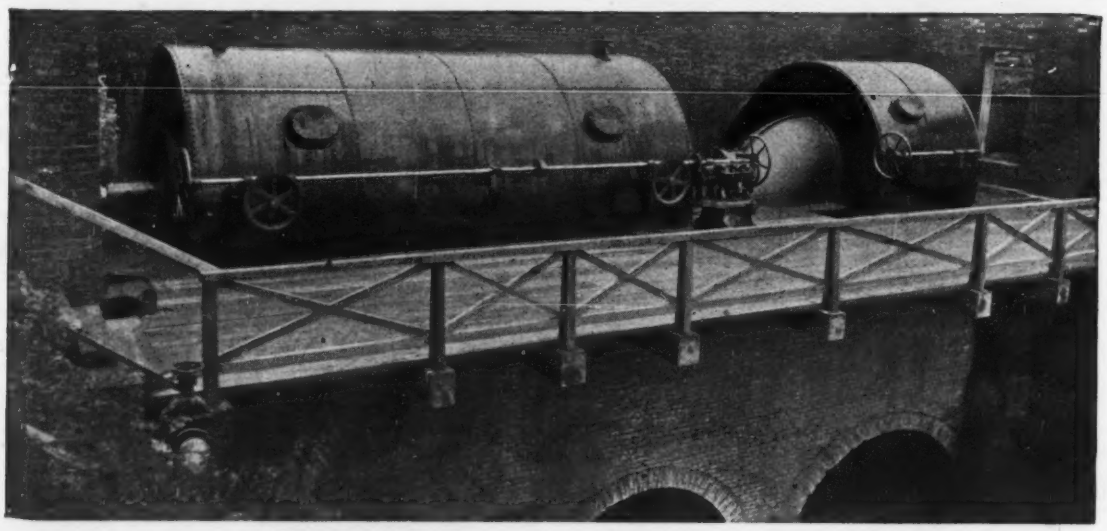


Fig. 2.—51-inch Turbines on Horizontal Shafts.

A Remarkable Lamp Test.

The following table shows the results of a series of tests on six Packard lamps, giving candle-powers and efficiencies at the end of each fifty hours in a continuous test of five hundred hours. The test was made by the electrical department of the Cincinnati Gas Light & Coke Company without the knowledge of the makers of the lamps:

SIX LAMPS, MARKED 16 CANDLE-POWER, 104 VOLTS.

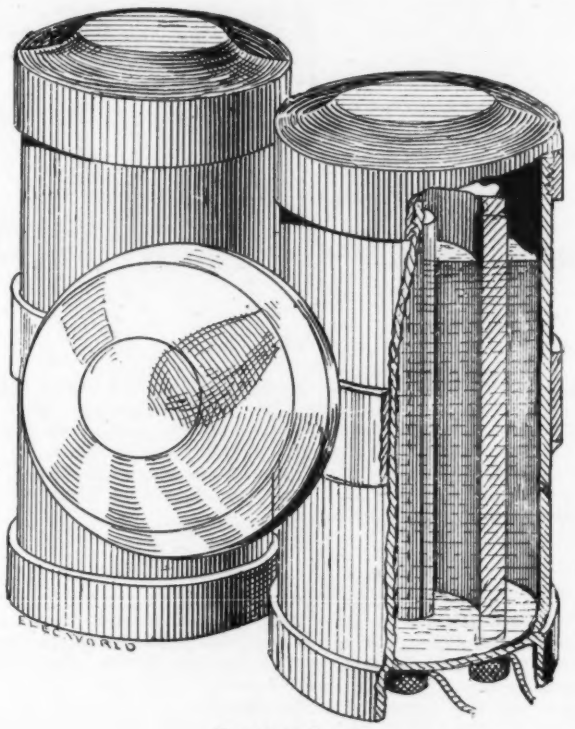
Average Measurements.

Hours.	Volts.	Amperes.	Total Watts.	Candle-Pr.	Watts Per CP.
Initial	104	0.5460	56.7800	16.1470	3.5100
End of 50 Hrs.....	"	0.5557	57.0442	16.3185	3.4473
" 100 "	"	0.5250	54.6000	16.4300	3.2633
" 150 "	"	0.5800	60.3200	16.4016	3.6776
" 200 "	"	0.5466	56.8464	16.3750	3.4715
" 250 "	"	0.5462	56.8048	16.3742	3.4691
" 300 "	"	0.5796	60.2784	17.1003	3.5244
" 350 "	"	0.5721	59.4984	17.0089	3.1452
" 400 "	"	0.5733	59.6232	16.1666	3.6880
" 450 "	"	0.5521	57.4184	16.1030	3.5035
" 500 "	"	0.5350	55.6400	15.6250	3.5609

(Test incomplete on account of accident to voltmeters.)

The Star Electric Bicycle Lamp.

A new primary battery bicycle lamp is being manufactured by the Star Electric Lamp Company, 39 and 41 Cortlandt Street, New York City. The complete lamp includes two vertically placed primary battery cells held in a metallic band holder which is attached to the lamp bracket on the wheel frame. Attached to the front part of the holder, between the two batteries, which are connected in series, is a small 2 cp enclosed incandescent lamp and reflector, mounted on an insulating switch block, which is fitted with a small single pole switch to connect the lamp with the battery. The battery elements are zinc and carbon and are acted upon by specially prepared solutions. An outer corrugated carbon cylinder is rigidly fixed in each of the hard rubber jars, leaving a space between the carbon and the inner walls of the rubber jar. The zinc element consists of a zinc rod having a longitudinal hole



BICYCLE LAMP.

and is slipped over a centrally placed rod fastened to the bottom of the battery jar and which acts as the terminal connection. To renew the zinc it is only necessary to slip off the old and replace with a new rod, no connecting of any kind being necessary. Two solutions are used, a strong one on the outer side of the carbon cylinder and a weaker one on the inner side acting on the zinc, making this practically a two-solution battery. Each jar is fitted with a rubber cap which screws firmly to the top.

A New Type of Transformer.

The lack of efficiency and regulation in the older types of transformers has been a very fruitful source of trouble to station managers and their customers. Not only does the lack of efficiency entail a continuous expense for current upon the station, but the poor regulation is responsible for dissatisfaction on the part of the customer and short life of even the best lamps, another source of much expense.

After considerable experience the New York & Ohio Co., Warren, O., manufacturers of the Packard Transformer, has placed upon the market a new type, designed to obviate these difficulties as far as may be possible. It was felt at the outset that considerations of price should not rule in the design of a transformer, since a cheap and inefficient machine of this character soon wastes enough current to more than pay for a properly-designed converter. It was also evident that radical departures from the commonly-used types were indicated by the conditions, and that a design to be useful must have features of originality.

Guided by these considerations, the Company has brought out the type of transformer illustrated herewith, which combines several distinct features of originality. The coils are circular and are wound on vulcabeston spools, which are then filled with a homogeneous insulating compound, making the completed coil a compact and impervious mass. The iron laminae are so designed that with a very short magnetic circuit they have but one break in their continuity, and are worked far below saturation.

Ventilation and cooling have been made important considerations in these transformers. The radial arrangement of the iron laminae presents a radiating surface relatively some thousands of times larger than that possessed by closely packed plates, and the arrangement of the transformer proper in the circular case provides for the constant circulation of a current of air around its inner circumference. This gives the advantages of an air-blast transformer without the need for special mechanism to secure ventilation.

The great freedom from heating obtained in this way, and the permanence of the solid insulating compound, which is practically integral with the vulcabeston coil spools, give the advantages of an oil transformer without the unpleasant concomitants of liquid insulation.

The regulation of a transformer vitally affects the life of the lamps

NEW TRANSFORMER.

connected to it, while its efficiency has a direct bearing upon the coal pile at the station. It is claimed for this new type that its regulation is better than 2.25 per cent. in small sizes and that in larger capacities it is within 1.2 per cent., while its efficiency is very high on small loads. Owing to the short and efficient magnetic circuit the magnetizing or no-load current is reduced to a minimum, an important consideration for the station manager. Two detached single-pole fuse boxes are furnished with each transformer, their type being well shown in the cut.

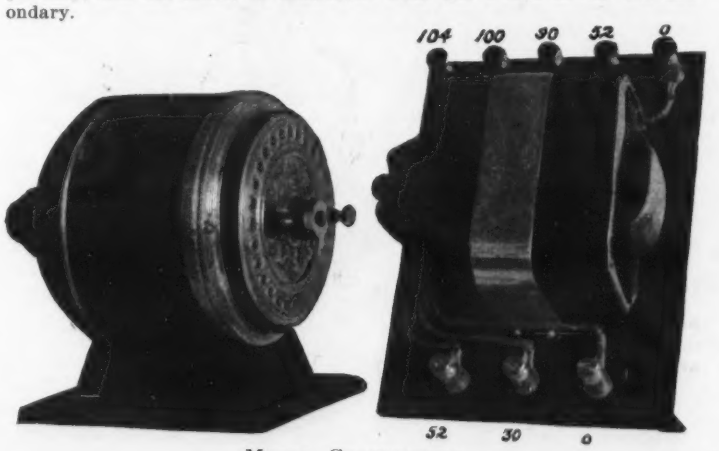
A Special Motor Combination.

The combination illustrated herewith was designed by the Emerson Electric Manufacturing Company, 714-718 St. Charles Street, St. Louis, Mo., to operate a vitascope. It consists of a 52-volt, 16,000-alternation motor, of the Company's standard M. 1 type, and a converter or economy coil, with the primary arranged for 52, 90, 100 and 104 volts, and the secondary designed to give 52 and 30 volts. With this combination the motors can be operated on 50 or 100 volts, 16,000 alternations, and 50 and 100 volts, 7,200 alternations, or on any voltage or alternations approximating these.

On 50 volts, 16,000 alternations, the converter is not used, as this is the voltage and alternations for which the motor is wound.

On 100 volts, 16,000 alternations, the current is lead into the 0 and 100 volt posts on the primary, and the motor is connected to the 0 and 52 volts.

On 50 volts, 7200, the current is lead into the 0 and 52 volt on the primary, and the motor is connected with the 0 and 30 on the secondary.



MOTOR COMBINATION.

On 100 volts, 7200 alternations, the current is lead into the 0 and 100 on the primary, and the motor is connected to the 0 and 30 on the secondary.

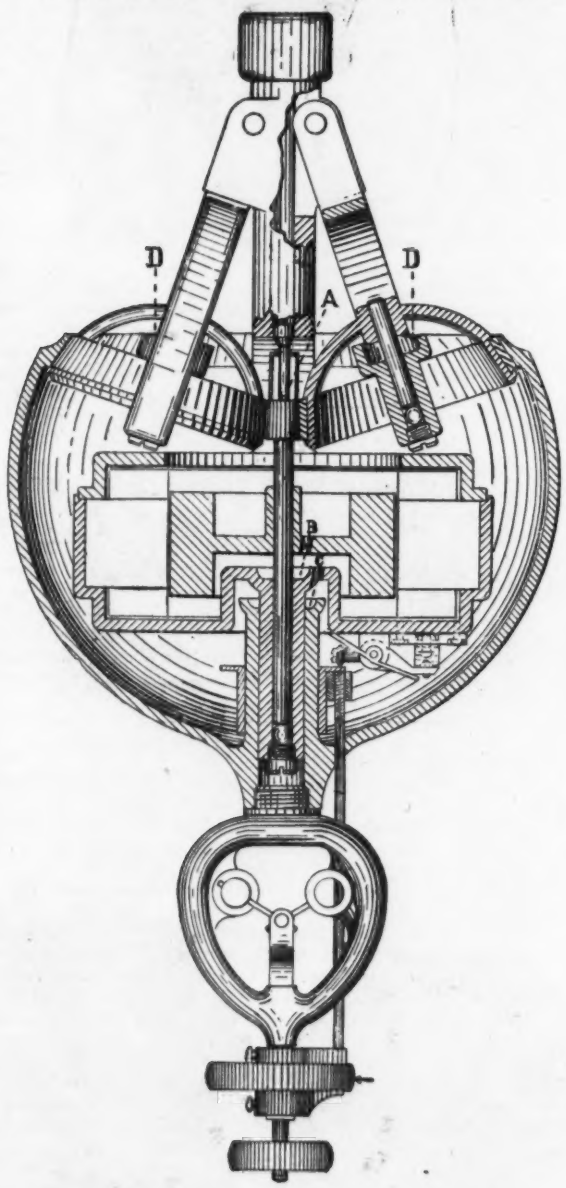
The two posts on the primary marked "104" and "90" are given for adjustment. In case the motor is a little too strong, or the voltage a little too high, the primary would be connected to the 104 instead of the 100. In case the motor was a little too weak or the voltage a little too low, it would be connected to the 90 volt post, instead of the 100.

This combination is claimed to be the only practicable method of operating a machine such as a vitascope, and if handled properly will give satisfactory results, for the reason that it is flexible in its application. It can be used under varying conditions and on any alternating current which may be found in moving the instrument from place to place for exhibition purposes.

A New Alternating Current Ceiling Fan.

The inefficiency of ordinary types of small power, low-speed alternating-current motors, and the difficulty of constructing a small low-speed induction motor for ceiling fan work, have been grave obstacles in the way of the success of machines of this type for alternating circuits. The 1897 type of the Tuerk alternating-current ceiling fan, illustrated herewith, is a very ingenious and successful solution of the problem, and embodies a radical departure from the usual practice in fan construction.

An induction motor, working at 1800 revolutions per minute, carries on its vertical shaft a small conical bearing surface against which run two rollers. These are mounted on ball-bearings and are hung from the vertical supporting rod of the machine, so that they bear against the revolving surface on the motor shaft and rotate in planes at a considerable angle with the horizontal. The globular shell, which surrounds and protects the mechanism, carries beneath it the two blades of the fan. This shell is open at the top, and has an inwardly projecting flange on which is turned up a bearing surface, resting on the two rollers. The weight of the globe and fans furnishes a sufficient pressure to keep the four rolling surfaces in contact, while the total elimination of ordinary bearings enormously reduces the friction of the various parts of the mechanism.



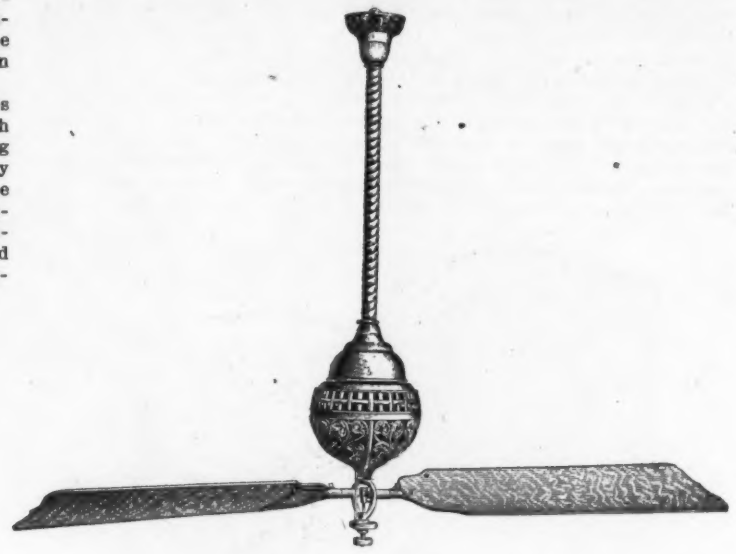
Cross Sectional View of Fan Mechanism.

The lower end of the vertical motor shaft is hardened and bears upon a single ball. Oil capacity is provided in a single chamber sufficient for a season's work without renewal.

The fan is controlled from below by two small hand wheels, one of which operates a double-break switch, while the other sets the blades at various degrees of inclination, which may be changed while the fan is running.

All parts of the mechanism are fully accessible, and easy of inspection. No provision is made for keeping dust out of the mechanism, since the bearings are dust-proof, and there is no commutator to be kept clean. The relation of the rolling surfaces, which transmit the power of the motor to the fan, is such that any wear which may occur is taken up automatically. The current consumption of these fans, running at 150 revolutions per minute, is from 120 to 140 actual watts, depending upon the position of the blades. The fans are made for single phase or polyphase circuits of voltages between 50 and 120, and frequencies of 60, 125 and 140 cycles per second.

The design of the exterior of the fans is pleasing and graceful, being

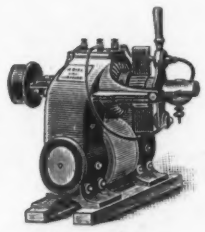


Alternating Current Ceiling Fan.

finished in Bower-Barff, bronze, nickel, ivory and gold and polished cast brass. They were put upon the market, in a less complete form, in the Spring of 1896, and the great demand for them encourages the manufacturers, the Hunter Fan & Motor Company, Fulton, N. Y., to believe they will be largely used during the coming season. The Eastern agency has been placed exclusively in the hands of Messrs. E. B. Latham & Co., 136 Liberty Street, New York City.

Motors and Bells.

The motor illustrated is one of a line of this class of machines made by Clymer & Heilman, manufacturing electricians, Reading, Pa. The machine, it will be seen, is of the bipolar type and of compact design, the armature bearings being provided by arms extended from the poles. It is provided with a rocker arm for the purpose of setting the brushes at the non-sparking point, and altogether a good ventilation of all parts is obtained. The magnetic circuit is simple in design and construction, only one spool being used, as shown. These machines are made in all sizes and voltages, the one illustrated being of the 1-12 horse-power size, 110 volts. They are all reversible.



1/12-hp Motor.

Electric Bell.

The wooden box-bell made by this firm possesses some points of excellence which will be appreciated by the trade at large and users of these indispensable devices. They, like the motors, are of first-class workmanship and well finished, and give satisfaction in practical use.

Electric Mining.

The Moon Run Coal Company, Moon Run, Pa., is about to install an electric haulage-plant in its colliery, and to this end has contracted with the General Electric Company for electrical equipment, sufficient to operate a mine road with over three and a half miles of track.

The generating plant will consist of one 165 kw 250-volt generator directly connected to a Harrisburg Ideal engine 18½″ by 16″. These with the switchboard will be set up in the present power-house, which at present contains an air-compressor plant for the operation of certain pick machines. The inside haulage will be handled by one ten-ton mining locomotive, equipped with 40 hp motors. This will haul forty loaded cars per trip, each loaded car weighing about two and a half tons. There will be over three and a half miles of trolley wire in the mines with the necessary feeders.

It is worthy of note that electricity was not adopted by the Moon Run Coal Company before it had made a more than careful investiga-

tion of the merits of all other systems of mechanical haulage, cable, compressed air and steam. The economical showing exemplified by the results obtained in the many other mines now using the General Electric Company's system of electric haulage proved conclusively the advantage which would accrue to the Moon Run colliery by the introduction of electricity.

A Multiple Attachment Plug.

It is a matter of almost practical impossibility to arrange the incandescent lighting system of a building so that in every case the lamp is placed where it is most wanted. It is only possible to approximate this result by arranging the wiring outlets for chandeliers, brackets, drops, etc., so that a good general illumination is provided, or by providing an outlet for the necessary lighting fixture in each specific case where it is assumed illumination will be most needed at the time of installation. The demands for such illumination are, however, constantly changing.

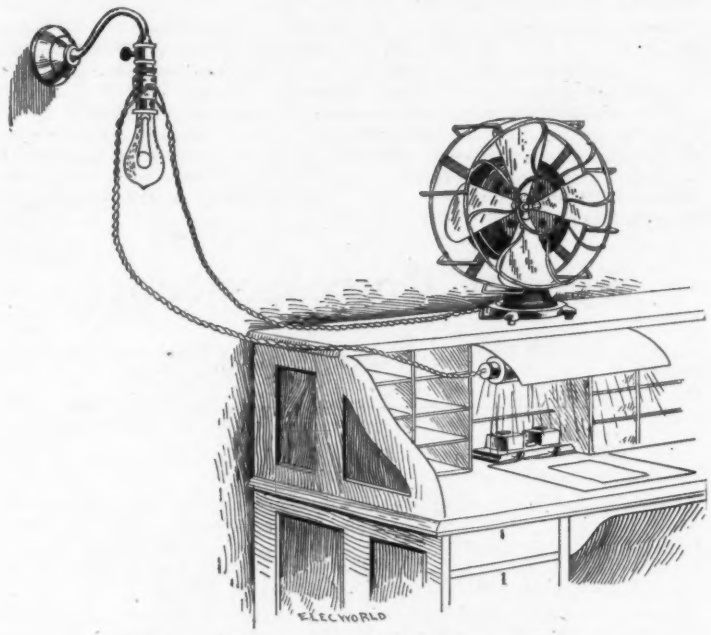


FIG. 1.—APPLICATION OF ATTACHMENT PLUG.

It may be necessary to provide desk lights in an office, provided with only one or two fixed lighting fixtures, an additional light may be required by the mechanic at the bench or lathe to better illuminate his work, an electric fan may be required where no specific wiring arrangement is made for its connection, and, in fact, innumerable other instances arise where current for an incandescent lamp, motor or other device is needed for more or less extended use at some point away from the fixed outlet. An ordinary attachment plug and flexible cord connection has usually served for this purpose, but the insertion of the ordinary attachment plug in the socket means the loss of the lamp at that particular point. This is far from desirable, as the lamp removed

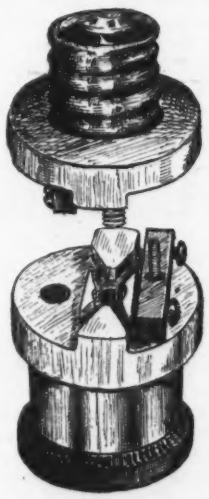


FIG. 2.—ATTACHMENT PLUG.

may be equally necessary. A device for simply tapping the current from the socket at the fixture without necessitating the removal of the lamp seems to be a more satisfactory method than the present ordinary attachment plug provides.

An improved multiple attachment plug accomplishing this result has recently been introduced by J. C. Vetter, 104 East 23d Street, New York City. This device is an attachment plug and socket combined, and can be inserted in any socket, the lamp being simply transferred to the plug receptacle, as shown in Fig. 1. In Fig. 2 the two distinctive parts of the device are separated, so as to clearly show its construction. Both the plug and receptacle are each separately mounted on porcelain bases, which are clamped together by screws with the tap terminals between, as shown. The outer terminal of the plug, which is of any desired standard type, connects to the top terminal on one side of the porcelain base by means of a screw passing through the porcelain from the terminal to the outer plug contact. The inner contact terminal of the plug passes through a hole in the centre of both porcelain bases into the socket part. The other tap terminal is connected to the centre plug contact pin by means of a small fuse connector, placed in the grooves in the porcelain base, as shown. A screw, connected with the outer receptacle terminal, passes through an insulated hole in this tap terminal, connecting the outer contact of the receptacle with the outer contact of the plug. This serves at the same time to hold the tap terminal in place and also hold the two parts of the device together in connection with the central receptacle contact, which is a small nut screwed to the end of the centre-plug pin which projects into the receptacle. The fuse is placed in the groove, one end making contact with the centre pin and the other under the tap-contact terminal. The tap terminals are each provided with two screws on their outer sides, one at each end. It is therefore possible if desired to take two taps from each plug. The receptacle contacts are protected by an insulated nickeled shell held to the porcelain base.

Linemen's Torches.

"The All Right Family" is the name given to four torches manufactured by the Clayton & Lambert Manufacturing Company, Ypsilanti, Mich., which are claimed to be the best that special skill can produce.

All of these torches are fitted with round burners, have powerful generators and produce a large pure blue flame with very intense heat. Another claim is that these torches consume less gasoline than those of other makes, and at the same time give stronger fire.

FIG. 1.

FIG. 2.

The needle points are quick-opening and are fitted with stuffing boxes so that no trouble from leaky needles need be feared. They are double soldered, and can be turned tight with little or no wear on the metal.

The "All Right" torch (Fig. 1) is ready for business at a moment's notice, and works in the heaviest winds. The flame is very powerful and fully under the control of the user. It is specially adapted for outside work.

The "Junior" torch (Fig. 2) is smaller than the "All Right," and is particularly adapted for inside work. It is substantially constructed of heavy brass; will bear hard knocks, and can be carried around in a kit without damage. The flame is just right for inside wiring work, and can be run as fine as desired. This torch is a favorite among electricians.

The "Pet" of this torch family is shown in Fig. 3. It is the same as the "Junior" in its fittings and possesses all of its advantages, the only difference between the two being in the shape of the tank and the handle, the latter being adjustable. By the proper use of the thumb-screw

FIG. 3.

FIG. 4.

at the end of the handle the latter can be turned to any point desired.

The "Twin" torch (Fig. 4) combines all of the good points of the "All Right" and "Junior," and can be relied upon to meet the requirements of any electrician.

These torches are highly recommended for the use of electric wiremen and others, and letters in the possession of the Clayton & Lambert Manufacturing Company prove that users of the same are perfectly satisfied with their operation and lasting qualities.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 2, 1897.

ELECTRICAL STOCKS are much firmer than they were at the time of last report, every change in quotation being, without exception, an advance. The advances were substantial, and there is a stronger tone to the general list. In the bond list, General Electric debenture 5s lost ⅛ point since last quotation.

TELEGRAPH AND TELEPHONE.—In this list of securities nothing especially noteworthy can be recorded. The market at the close of our report was devoid of any feature. Some gains are recorded, as well as some losses, the only marked change being in Commercial Cable, which is 4 points lower than it was at the time of our last report. Bell Telephone holds firm in Boston, while Erie Telephone receded ½ point.

ELECTRIC TRACTIONS.—Few stocks in this list show any change, quietness being the prevailing feature at the time of closing this report. In Boston West End took an upward jump of 3 points on Wednesday on the strength of active buying, which advance was thought to be due to supposed approaching favorable legislation. Some changes in the railway bond list are recorded.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	105½	106
" " " Brooklyn	100	..	97
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27	28
Electric Storage, pref	100	29	30
General Electric	100	35	35¼
General Electric, pref	100	75	77
Westinghouse Consolidated, com	50	24½	25
" " pref	50	50¼	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	108	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	95	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	224	225
American District Telegraph	100	29	39
American Telegraph & Cable	100	85	87½
Central & South American Telegraph	100	124	127
Commercial Cables	100	156	172
Erie Telephone	100	66½	68
New England Telephone	100	102¾	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	83¾	84¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18¼
Brooklyn Rapid Transit	..	21	21½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	68	72
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	39	42
Hestonville	100	51	51½
" pref	..	..	62½
New Orleans Traction	100	..	10
" " pref	100	..	35
North Shore Traction	100	20	23
" " pref	100	77	80
Rochester St. Ry	..	18	22
Steinway Ry	..	45	50
Union Railway (Huckleberry)	..	98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	74¼	74¾
" " pref	100	91	92
Worcester Traction	100	20	22
" " pref	100	94	97
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	80¼	..
Buffalo St. Ry. 1st con. 5s	100	*106	108
Cleveland Elec. Ry. 1st mtge. 5s	100	103	105
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	*101	104
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

THE NASSAU ELECTRIC RAILROAD COMPANY, Brooklyn, reports for the quarter ending Dec. 31, 1896, gross earnings $367,782, an increase of $285,642, as compared with the gross earnings during the corresponding quarter in 1895. The operating expenses during the same period were $237,365, an increase of $177,462; net earnings $130,416, increase $108,180. The surplus account decreased $38.

THE COMMERCIAL CABLE COMPANY, in its report for the year ending Dec. 31, 1896, shows gross earnings during that period of $2,019,255, an increase of $9,517 over the gross earnings in 1895; expenses $842,690, an increase of $48,349, leaving net earnings of $1,176,565. Of this amount $800,000 were paid in dividends, leaving a surplus of $376,565. The increase in expenses was due to cable repairs, eight having been made during the year, against five during 1895. The balance of undivided profits carried forward was $846,678. The reserve fund was increased $250,000, invested in first mortgage bonds of the Commercial Cable building.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 4, 1897.

DR. S. S. WHEELER sailed on March 2 for Bermuda, where he will spend three weeks in pleasure and rest.

ELECTRIC FOUNTAIN.—An electric fountain is to be erected on the Plaza at Prospect Park, Brooklyn, to take the place of the former fountain, which has just been demolished. The new electric fountain will be similar to the one at the World's Fair and that at Willow Grove Park, Philadelphia, and will cost, it is estimated, $15,000.

OUT-OF-TOWN VISITORS.—Among the out-of-town callers at the headquarters of the National Electric Light Association during the week ending Feb. 27 were the following: F. R. Donahoe, Chicago, Ill.; G. W. Vallee, Philadelphia, Pa.; James Bradley, Boston, Mass.; E. A. Colby, Newark, N. J.; C. E. Scott, Bristol, Pa.; C. F. Munder, Springfield, Mass.; A. H. Pease, Hartford, Conn., and I. R. Prentiss, Cleveland, O.

THE BOARD OF ELECTRICAL CONTROL.—A bill is to be introduced at Albany providing for the continuing of the Board of Electrical Control from Nov. 1 next, when it expires by legal limitation, until Jan. 1, 1898, when the present Board will be merged with the new one, as provided in the new charter. Under the provision of the new charter the work of the Board of Electrical Control will devolve upon the Board of Public Improvements.

DAMAGE TO WATER AND GAS PIPES IN BROOKLYN BY ELECTROLYSIS.—Recently escaping gas on Classon Avenue, Brooklyn, led to an investigation and the discovery that a gas pipe at that point was eaten away for a distance of two feet presumably by electric current. Both the Brooklyn Union Gas Company and the Edison Electric Light Company have recently been making investigations with a view to determining the amount of damage to their respective underground plants since the trolley lines went into operation. It is stated that the city authorities will make the matter a subject of official investigation.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., March 2, 1897.

MR. C. E. BIBBER, treasurer and general manager of the Bibber-White Company, Boston, has just started on a brief business trip to Minneapolis, Chicago and other Western points, in the interests of his company.

THE ANCHOR ELECTRIC COMPANY, Boston, has just issued catalogue No. 6, devoted particularly to "Electric Lighting Supplies." It is a decidedly neat compendium and will, undoubtedly, command deserved appreciation by central stations and all interested in electric lighting.

MR. C. O. BAKER, manager of the Western business of the Anchor Electric Company, with offices in the Monadnock Block, Chicago, was a Boston visitor last week. Mr. Baker is a very agreeable gentleman and is conspicuous in the list of successful electrical business men in the West.

THE LYNN INCANDESCENT LAMP COMPANY will shortly remove into its new factory at Lynn, Mass., where it will have abundant space and most excellent facilities for the conduct of its already large and growing business. The success of this company in the renewing of burned-out lamps is something remarkable.

THE PETTINGELL-ANDREWS COMPANY, Boston, is meeting with remarkable success in introducing to the electric roads of New England the excellent new line material of the Billings & Spencer Company. In fact, the business of the electric railway department of this company has been unusually good for some time, as has also its general business. This company has a strong hold in New England, which the firm and energetic efforts of Messrs. Price and Andrews will keep.

THE PARAGON ARC LAMP COMPANY, Devonshire Building, Boston, has just issued a strikingly beautiful and artistic production representation of its various styles of lamps—series lamp of 15 hours, for direct and high potential circuits; plain, long-burning enclosed arc of 150 hours, for direct incandescent circuits; ornamental long-burning enclosed arc, for direct incandescent circuits, and low potential lamp, two in series. Conover & Goe, Monadnock Block, Chicago, are the Paragon Western agents.

MR. JAMES L. GETHINS, of Boston, who recently resigned his position in the electrical department of the Boston Fire Alarm Service, which he had held creditably for a long term of years, is now located in business for himself at 181 Tremont Street, and 437 Dudley Street, in the electrical contracting line, with which he is thoroughly familiar in all its details. Mr. Gethins is also well and favorably known as the inventor of the Improved Gethins Gravity Battery. The special feature of his present business will be the Gethins combination of gravity and storage batteries (chloride), furnishing complete storage battery outfits of all kinds, particularly for isolated plant work, and making also a specialty of outfits for Rontgen-ray induction coils, physicians, surgeons, dentists, etc. Mr. Gethins deserves the success which we hope and believe he will achieve, and which has already manifested itself.

MARRIED.—Miss Isabelle Ridlon, daughter of Mr. and Mrs. Frank Ridlon, of Boston, and Mr. John Otis McFadden, one of Boston's prominent merchants and a leading member of the Ancient and Honorable Artillery Company, were married on Wednesday evening, Feb. 24, at the handsome residence of Mr. Ridlon, in Dorchester, Mass. It was a very pretty wedding, the ceremony being private and simple, there being no bridesmaids or best man. At the reception, which followed, the large and spacious residence of Mr. Ridlon was taxed to its utmost to accommodate the large circle of friends in attendance, among which the electrical fraternity was, of course, largely represented. The wedding presents were numerous, varied and costly. Mr. and Mrs. McFadden left for New York, whence they embarked on steamer for Nassau, and from there they will go to Mexico and California. They will return about May 1.

THE CURTIS ENGINEERING SPECIALTIES continue to grow in both age and popularity. In fact, notwithstanding their many years of use, their value and efficiency appear to be recognized to a greater extent than ever. The Curtis regulator, Curtis steam traps and Curtis separators are known everywhere and are installed in numerous electric light and power plants, the largest steam power plants, and in the most notable manufacturing establishments, office buildings and hotels throughout the United States. The list of users, as published in a catalogue, is sufficiently formidable to attest their popularity, and evidences quite conclusively that they are holding their own as "pioneers in the close, accurate and automatic regulation of pressures, either of steam, water or air." The D'Este & Seeley Company, 29-33 Haverhill Street, Boston, is the manufacturer of these well-known specialties, of which company Mr. Nelson Curtis, the inventor of the same, is secretary.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., March 1, 1897.

LECTURES ON NIAGARA WORK.—At Niagara Falls a course of lectures, illustrated by stereopticon, is to be given during March. On March 5 the subject will be "How Niagara Does Its Work," by A. H. Van Cleve; March 12, "Electricity," by P. M. Lincoln, and March 19, "Carborundum," by F. A. J. Fitzgerald.

LIGHT AND POWER FOR DEPEW.—Incorporation papers for the Depew & Lancaster Power, Light & Conduit Company have been filed in the County Clerk's office. The company is incorporated with a capital stock of $20,000, for the purpose of furnishing light and power in Lancaster and Depew. The directors for the first year are John N. Scatcherd, J. L. Hunsicker, George R. Teller, William B. Rogers and Martin Carey.

BUFFALO FIVE-YEAR LIGHTING CONTRACT.—The Lower House of the Buffalo Board of Aldermen passed upon the matter of a contract for electric lighting by a vote of 22 to 1 in favor of the Buffalo General Electric Company. Alderman Kennedy said that the bid of the electric light company is lower than ever before. He believed that the first cost of the municipal plant would be very heavy, on account of the large territory which would have to be covered. The local electric company pays $23,000 a year taxes. Alderman Smither showed how the city, under the contract, will pay $109.50 per lamp per year, while Toronto, under contract, pays $74.82, and Detroit, under municipal ownership pays but $68.52 per lamp per year. Alderman Franklin claimed that Alderman Smither was not fair in his quotations. Instead of costing $68.52 in Detroit, it really cost $84.70, and the cost in Buffalo will be $100, instead of $109.50. He protested that in case of wanting to go into municipal ownership the city should take the plants of the existing companies by condemnation proceedings.

NIAGARA FALLS, N. Y., Feb. 27, 1897.

MR. CHARLES M. HALL, vice-president and Niagara Falls manager of the Pittsburg Reduction Company, is lying dangerously ill here with typhoid fever. Mr. Hall is the inventor of the electric furnace and process of extracting aluminum used by the Pittsburg Reduction Company.

THE CARBORUNDUM COMPANY.—Several well-known Pittsburg bankers and stockholders in the Carborundum Company visited Niagara Falls last week and looked over the Company's plant. The result of this visit, according to General Manager Edward G. Acheson, was the decision to duplicate the present plant at once and ask the Niagara Falls Power Company for another block of 1000 electrical horse-power. It is not likely that this power can be secured for several months yet, but in the meantime preparations are being made for building additional electrical furnaces. One of the near possibilities, Mr. Acheson stated, was the formation of a new company and the erection of a factory in Niagara Falls for the manufacture of carborundum paper and cloth. As a result of the moving of the factories of the Carborundum Company to the Falls carborundum is to-day, he said, sold to the consumer at one-half the amount of the actual cost of production at Monongahela, Pa., where the original plant was established. This, he stated, was the result of decreased cost of power, and the facilities afforded by using large units.

CANADIAN TARIFF COMMISSION.—The Tariff Commission, which was appointed by the Canadian government to sound the different industries of Canada as to their feeling in regard to tariff duties, has been holding hearings throughout Canada for the past two months. The Commissioners on Feb. 23 held a meeting at Ottawa, at which the electrical manufacturing companies were represented. The most important delegations were from the Canadian General Electric Company, Peterboro and Toronto. Mr. Jaffary, of this Company, argued that if there was a reduction of duty on finished electrical goods a corresponding reduction in the component materials should be granted. The home competition was very keen, he stated, and a large competition existed from the United States manufacturers, as the duty on finished goods was now protective. Commissioner Dobell suggested that the Company was fortunate in that the site of its factory cost much less than it would in the United States, to which Mr. Jaffary responded that there was a lot of cheap land in the United States, and one could go into almost any city there and get a free site for a factory.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Feb. 27, 1897.

MR. JOHN MURPHY, of the Indianapolis Electric Company, Indianapolis, Ind., while in Chicago, paid a visit to the Chicago office of THE ELECTRICAL WORLD on Feb. 24. He reports business in a good condition in his section.

MR. E. WARD WILKINS, of The Partrick & Carter Company, Philadelphia, called at the Chicago office of THE ELECTRICAL WORLD during the past week, on his return from a visit to the Pacific Coast. He reports having an exceptionally successful trip and states that an announcement of The Partrick & Carter Company's agencies will be made shortly.

ST. LOUIS NOTES.

ST. LOUIS, MO., March 2, 1897.

NEW ELECTRIC ROAD.—Surveyors are at work on a new projected road to run from Clayton, the County seat, to Creve Coeur Lake.

TO CONSOLIDATE.—It is reported that the Eads Bridge Street Car Company and the East St. Louis street car lines will, within the next few days, be consolidated, and carry passengers between East St. Louis and St. Louis for one fare.

SHAW AVENUE LINE.—Articles of incorporation have been filed by the Shaw Avenue Electric Railway Company. J. D. Houseman, of the St. Louis & Kirkwood road, is back of the scheme. He wants an outlet to free himself from the Lindell road.

WITHDRAWN FROM THE FIELD.—The Board of Public Improvements has received notice that the Telephone and Telegraph Service Company will not occupy certain space in the joint conduit, which is an acknowledgment that it has withdrawn from the field. This leaves the Bell, the American and Kinloch people the field to themselves.

MAY COMBINE.—The meeting of the International Electric Company, of this city, which was to have been held last week, has been postponed until some time this week, pending the arrival from New York of William O'Keefe, who went to make terms with the "incandescent lamp combination" which includes the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Columbia Incandescent Lamp Company, of this city; a concern at Springfield, Mass.; another at Chicago, one at Cleveland, another at Warren, Ohio, and a few others in other cities. The scheme is to combine all companies manufacturing incandescent lamps so as to have all patents covering the various parts of the lamps controlled by one organization. The combination was effected by James H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of this city, which is the third largest concern in the combine.

Pittsburg Notes.

Pittsburg, Pa., March 1, 1897.

THE ARISTOCRATIC SUBURB OF SEWICKLEY is wrought up to a high state of excitement over the proposition to disturb the restful peace of its quiet streets by the introduction of the inevitable trolley car. An ordinance granting rights of way to the Sewickley Valley Electric Passenger Railway Company came up for final passage on Feb. 23 at a special council meeting, which was attended by a crowd of prqtesting citizens. The ordinance was defeated by a unanimous vote in deference to the expressed wishes of the property-owners representing, it is said, one-third of the assessed valuation of the town. It is stated that the ordinance will be given another trial when the newly-elected Council comes into power. The Sewickley Valley Company proposes to connect with the Coraopolis branch of the Second Avenue Traction Company, which would give practically a continuous line between Sewickley and Pittsburg. It is understood that the Sewickley Valley Company is backed by the Second Avenue Traction Company, and the Sewickley tracks will be an important link in its proposed line from Pittsburg to Rochester and Beaver Falls.

TRACTION COMPANIES TO PAY TAXES.—For many months a controversy has existed between the municipal authorities and certain street railway magnates in Allegheny concerning the amount of compensation the city is entitled to for franchises, etc. Some time ago the councils passed an ordinance requiring the traction companies to pay into the city treasury each year 4 per cent. of their gross receipts. The companies demurred, and a special Committee of Councils was appointed to bring about an agreement if possible. Several conferences were held with the officials of the Pittsburg, Allegheny & Manchester and the Federal Street & Pleasant Valley Companies, the latter contending for a 2 per cent. tax, while the representatives of the city held out for 4 per cent. Finally on Feb. 23 the committee is reported to have offered to compromise on a basis of 3 per cent., and it seems probable that this proposition will be acceptable to the interests affected. The Pleasant Valley Company furthermore agreed to pay for certain street paving on Perrysville Avenue and other streets, and suits which had been brought by the city against the company to compel this will therefore be dropped. It now looks as though these long-standing differences between the city and the traction companies were in a fair way toward satisfactory settlement.

THE FLOOD that swept down the Allegheny and Monongahela rivers on Feb. 23 proved to be one of the most disastrous that has occurred for many years. The electrical interests suffered heavily along with the others. Although in most cases the damage consisted mainly in interruption of service, yet in a number of instances considerable actual destruction of property was done. The electric-lighting plants at Monongahela City, McKeesport and Braddock were inundated to such an extent that they had to suspend operation entirely, and these towns were in total darkness for one or two nights. The tracks of the Second Avenue Traction Company were under water in several places between Pittsburg and Braddock for many hours, and the West End road was also flooded. Both of these companies were compelled to transfer passengers at the flooded places. The Pittsburg, Allegheny & Manchester road and the Pleasant Valley road were both covered so that cars could not reach their respective bridges, and passengers were compelled to walk between Pittsburg and Allegheny. In the lower portions of the two cities cellars and basements were flooded, and many isolated electric plants in mills and business houses were compelled to shut down. At East Pittsburg the water from the Monongahela backed up the Turtle Creek valley and reached a point eighteen inches above the previous highest water-mark. The Westinghouse Electric & Manufacturing Company was obliged to suspend operations for a couple of days. The Westinghouse Machine Company, by dint of vigorous pumping, was able to keep its power plant going, and lost no time except in the foundry. Down the Ohio, equally serious results were caused by the high river. At Wheeling, street car passengers were transferred across flooded places in boats, and the lines crossing the river were forced to stop running. The East Liverpool and Wellsville line had its road-bed washed out in places, and traffic was interrupted for a considerable time. The total damage caused by the flood in the vicinity of Pittsburg is estimated at nearly $1,000,000.

Canadian Notes.

Ottawa, Ont., Feb. 27, 1897.

THE OTTAWA ELECTRIC RAILWAY COMPANY intends erecting a handsome pavilion at the West End Park, the coming Summer, capable of seating about 2000 people. It will cost upwards of $10,000.

ELECTRIC RAILWAY PROJECT.—If sufficient encouragement in the way of a bonus is given them, ten Hamilton men are ready to build and operate the Beamsville & St. Catharines Electric Railway. C. J. Myles, one of the capitalists referred to, says if the power can be obtained from Decew's Falls and St. Catharines people hold out the necessary inducement, the line will be constructed at once and will connect with the Hamilton, Grimsby & Beamsville Electric Railway at Beamsville. It is said this line would be speedily followed by a link from Thorold to Niagara Falls, and as there is already an electric road from St. Catharines to Thorold, this would complete an electric railway from Hamilton to the Falls.

TELEPHONE CHARGES.—The Governor-General in Council has received a petition from the Bell Telephone Company of Canada asking for permission to increase the rates charged to the public for the use of its telephones. In 1892 the Parliament of Canada passed an act authorizing the Company to increase its capital stock to $5,000,000. The Company says in its petition that owing to the introduction of electric light, electric railways and other electrical improvements, the Company has had to discard its plant in many cases and put in new plants. This, it says, has largely increased the cost of operating telephone exchanges and made necessary increased charges. The petition was referred to the Railway Committee of the Privy Council. The matter came up for hearing this week, and Mr. Blair said it would receive consideration.

THE BELL TELEPHONE COMPANY.—The seventh annual meeting of the Bell Telephone Company was held at Montreal this week. The annual report showed that 653 subscribers had been added during the year, the total number of sets of instruments now earning rental being 29,462; that the Company owns and operates 341 exchanges and 275 agencies, 176 miles of poles and 1013 miles of wire were added to the long distance system in 1896; of these, 11 pole miles and 236 wire miles are in the Ontario department and 165 pole miles and 777 wire miles are in the Eastern department. The long-distance lines, now owned and operated by the Company, comprise 15,864 miles of wire on 6060 miles of poles. The new building in Montreal is nearly completed, and will be ready for occupancy in May. The new building in Winnipeg was completed and occupied about Nov. 1, and fully answers expectations. Mr. Crawford expressed a doubt as to the advisability of extending the long-distance service. He did not consider it as profitable as the short distance.

English Notes.

(From Our Own Correspondent.)

London, Feb. 17, 1897.

HIGH VOLTAGE LAMPS.—The manufacture of incandescent lamps for voltages from 200 to 230 is now being carried out on a larger scale, as now a number of supply stations will only supply new connections at this higher pressure. The lamps have undergone slight changes since last year, the most notable change being the abandonment, by all makers, of the supporting wires preventing the filaments from touching the glass. At first all high voltage lamps could only be used in a vertical position, but now most of the types will have as long a life when burning in a horizontal position. The general pattern adopted is a two-filament lamp, some makers preferring the filaments face to face, others preferring to have them side by side. One maker claims to have solved the difficulty of preparing a single filament of sufficient length and stability by adopting a sinuous shape. These latter lamps, however, are not yet on the market. The general opinion among lamp manufacturers seems to be that the lamps will have the same life and efficiency ratio as the older 100-volt type, and I think they rely somewhat on the universal adoption of the higher pressure to improve the prices of lamps, which have now reached a ruinously low limit due to foreign competition.

AN ELECTRIC OVERHEAD RAILWAY FOR LONDON.—A scheme which has hitherto received but little attention has come before Parliament. The project is known as the West Suburban Railway Company, and will be a line some four and a half miles in length running from Paddington Station, the terminus of the Great Western Railway, across the outskirts of London to Willesden Junction, which belongs to the London & Northwestern Railway Company. The neighborhood traversed is a new and rising one largely populated by mechanics and small shopkeepers. The first two and a half miles of the line will be carried on a viaduct formed of steel columns 50 feet to 70 feet apart, supporting latticed girders, the height being 17 feet to 14 feet above the road. It is proposed to have no less than eleven stations on this four and a half miles. There will probably be a seven or eight-minute service, and the journey is expected to take twenty-five minutes. The trains at first will be two motor cars, of a kind similar to those on the City & London Railway.

THE NATIONAL PHYSICAL LABORATORY.—Yesterday afternoon a representative deputation headed by Lord Lister (President of the Royal Society), and including Lord Rayleigh and Professors Ayrton, Perry, Silvanus Thompson, John Hopkinson and other well-known electrical names, waited upon the Marquis of Salisbury at the Foreign Office to press the necessity for the institution of a National Physical Laboratory. The deputation suggested that a sum of 30,000 pounds sterling and an annual grant of 5000 pounds sterling would be sufficient to extend the Kew Observatory so that it could do more general standardizing work and commence investigations into the secular changes of matter, a matter of high scientific importance. It must be confessed that the deputation met with but poor success. The Marquis of Salisbury is himself well versed in science, but notwithstanding this fact he adopted the usual departmental tone. The net result was an intimation to the deputation that if they were to confine their ideas to the extension of standardizing duties of the Government, there might be some chance of this being done, but they would be well advised to defer the grandiose idea of a National Physical Laboratory until—the Greek kalends.

General News.

New Incorporations.

THE IDAHO SPRINGS ELECTRIC LIGHT COMPANY, Idaho Springs, Col., has been formed by Frederick A. Moss, with a capital stock of $30,000.

THE DOWNIEVILLE ELECTRIC COMPANY, Downieville, Cal., has filed articles of incorporation with the Secretary of State. The incorporators are William V. Lockwood, R. B. Eilder and Robert Forbes. Capital stock, $20,000.

THE TONAWANDA POWER & LIGHTING COMPANY, Tonawanda, N. Y., has been formed with a capital stock of $150,000. The incorporators are William B. Rankine, of New York; George W. Davenport, of Boston, and Frank S. Smith, of Angelica.

THE AJAX LAMP COMPANY, New York, N. Y., has been organized with a capital stock of $100,000. Those interested are Bernard H. Pomeroy, Ernest Woltmann, Luther E. Shinn, David H. Gildersleeve, Henry A. Kirkham and Jacobi Loewenthal, all of New York, and Charles S. Van Nuis, of New Brunswick, N. J.

THE PENN YAN, KEUKA PARK & BRANCHPORT ELECTRIC RAILROAD COMPANY, Penn Yan, N. Y., has been incorporated for the purpose of operating an electric street railroad from Penn Yan to Branchport. The capital stock of the new company is $100,000, and the directors are William S. Reed, William H. Tybe and Frank H. Viele.

TELEGRAPH AND TELEPHONE.

MADISON, WIS.—The Wayne County Telephone Company is contemplating the building of a toll line from Madison to Lodi.

CONNEAUT, O.—It is stated that the existing dissatisfaction with the present telephone service may lead to the formation of a new company.

FAIRBURY, ILL.—The Council has granted a franchise for the establishing of a telephone exchange in this place.

MAGNOLIA, ILL.—The new telephone line between Magnolia and Henry has been completed and is now in practical working order. The lines connect with various places in this vicinity.

NEW LISBON, WIS.—A telephone line will be built between this city and Mauston. The poles have already been distributed and work will be continued until the line is completed.

BRISTOL, TENN.—The Bristol Telephone Company has completed its line between this place and Elizabethton. The line will be extended from Elizabethton to Mountain City, in Johnson County.

LANCASTER, KY.—The Lancaster Telephone Exchange has commenced work in the establishing of a system in this place, and much interest is manifested in the new enterprise.

COLUMBUS, IND.—The City Council has granted a franchise to the American Telephone & Telegraph Company, which proposes to extend its lines from Indianapolis to Louisville. The franchise was granted for a consideration of $1,000.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company, it is stated, will extend its lines in several directions in the Spring. The line to Rossville, Ga., has just been opened, and the Company is making preparations to run a toll line from Rossville and Chickamauga.

NASHVILLE, TENN.—A telephone line is being projected between Saltillo and Camden, including several other points. This line will give connection with the principal river points and communicate with the long-distance lines between Memphis and Nashville.

TULARE, CAL.—The Mount Whitney telephone line, running from Springfield to Tulare, a distance of 50 miles, and taking in various other points in Tulare County, has been completed. The line will be extended to all the large orchards and ranches in the county.

DETROIT, MICH.—It is stated that the Bell Telephone Company will meet the competition of the new Detroit Telephone Company by giving a $24 rate for residence instruments and a $36 rate for business 'phones, the new rates to go into force at once. The subscribers, however, will be enabled to take advantage of these reduced rates only under certain conditions.

LAKE CHARLES, LA.—It is reported that the Great Southern Telephone Company, of New Orleans, has absorbed the Dees Telephone Company, of this city, for a consideration of something like $4,000. The two companies have been in warm competition for the past two years, and had reduced prices so low that subscribers could get both services for less money than the usual rates of one company.

SAULT STE MARIE, MICH.—It seems to be now considered certain that the long-distance telephone service will be extended to the Soo. The Michigan Telephone Company is now building a line from Bay City to Mackinac, and the Straits of Mackinac will be cabled in the early Spring. Later on a line will be run from Marquette to the Soo, which will give direct connection with Chicago, Milwaukee and other points.

NEWARK, OHIO.—The Newark Telephone Company, which is an independent concern, has let contracts for the construction of a metallic line to Clay Lick, Hanover and various other places between this city and Long Run. The existing lines and proposed extensions will bring Newark into communication with some of the richest farming districts in the county. The Company is giving satisfactory service to more than 400 patrons.

NEGAUNEE, MICH.—The Bell Telephone Company in Negaunee and Ishpeming is installing free telephones in every house where permission can be obtained to put the instruments in. The Company is fighting the Marquette County Telephone Company, which was organized about eighteen months ago by the business men, as well as the Northwestern Electric Company, which is preparing to build its long-distance service all over the northern peninsula of Michigan.

MT. CLEMENS, MICH.—The new State Telephone Company, which was recently organized, has commenced the work of establishing an exchange in this place. It proposes to charge $24 a year for business telephones, $18 a year for residences, and 10 cents for conversations between this city and Detroit. These rates are a great reduction from those at present charged, and it is thought that the new company will get a foothold here. The Bell telephone local officials state that the Bell Company will meet rates and fight any competition.

BATTLE CREEK, MICH.—The business men of this city are pleased with the prospect of a new telephone exchange here. Officials of the new State Telephone Company, which was recently organized in Detroit, have been in consultation with prominent business men of this city, with the result that the Common Council was called in special session and a franchise granted to the new company for the new exchange. The company, it is stated, will put in 'phones for business purposes for $24, and for residences at $18 per year, and will provide the city with free instruments, and school houses for $12 a year each.

ELECTRIC LIGHT AND POWER.

WILKESBARRE, PA.—The City Council has authorized Charles White, of Philadelphia, to prepare plans for an electric light plant.

AUGUSTA, WIS.—J. L. Bell, a local capitalist, has been granted a fifteen-year franchise to furnish this city with electric lights and waterworks.

WESTERVILLE, OHIO.—Burton J. Ashley submitted his estimate to the Town Council of the probable cost of an electric light and waterworks plant, aggregating $26,270.

WINSTON, N. C.—The Winston aldermen have granted a franchise for running wires in the city for the transmission of Yadkin River power into Winston by electric current.

EAST JORDAN, MICH.—A local stock company is to be organized at East Jordan for the purpose of putting in and operating an electric lighting plant in the village.

WELLSTON, OHIO.—During the recent flood in the river the electric light station was submerged, and the employees had to be rescued by means of boats.

ALBANY, N. Y.—The Senate Finance Committee introduced a bill authorizing Superintendent of Public Works Aldridge to establish an electric light plant for lighting the Capitol; estimated cost of plant, $20,000.

MAUCH CHUNK, PA.—The Lehighton Town Council has decided to call a special election for March 30, for the purpose of voting on the question of issuing $10,000 bonds for the erection of an electric light plant.

HAMILTON, O.—The East Hamilton Electric Light and Power Company has been organized among East Hamilton business men for the purpose of supplying shops in that territory with electric light and power.

BUFFALO, N. Y.—The Board of Aldermen has granted the application of the Cataract Power & Conduit Company for an extension of time allowed in the original franchise for the delivery of the first 10,000 horsepower in this city. The Cataract Company thereby obtains six months' additional time in which to comply with the specifications of the grant.

OWATONNA, MINN.—The statement that the citizens of this place would vote on a proposition to build an electric light plant was erroneous. The Owatonna Electric Company was given the contract in January last for street lighting here, and this settles the question at least until December 31, 1900, when the contract expires.

BALTIMORE, MD.—The ordinance for the appointment of an Electrical Subway Commission of seven members was passed by the first branch of the City Council on Feb. 23 after being slightly amended. Prof. Henry A. Rowland is named as one of the members of the Commission. There does not seem to be any doubt of the passage of the ordinance by the second branch.

BLUFFTON, OHIO.—Bids were opened on March 1 for the sale of electric light bonds by the village of Bluffton, Ohio, to the amount of $8,000, bearing interest at 6 per cent. from March 1. The successful bidders were N. W. Harris & Co., Chicago, Ill., their premium being $722.50. Plans and specifications have been prepared and accepted by the Council, and bids for the plant will be opened on April 1.

SAN BERNARDINO, CAL.—The Southern California Power Company has been organized for the purpose of developing the water power of the Santa Ana River. The water will be delivered to water wheels at the Bear Valley Canal at a head of 1100 feet, generating 10,000 horse-power. These wheels will drive electric generators, and the current will be transmitted to Los Angeles, a distance of over 75 miles. The power will be used for the operation of electric railways and for lighting. The current, it is stated, will be transmitted at a pressure of 30,000 volts, which will be the highest voltage of any transmission plant in the world. The capital stock of the new company is $1,000,000, and the principal stockholders are Henry Fisher, of Pittsburg, Pa., and H. H. Sinclair, president and manager of the Redlands Electric Light & Power Company, Redlands, Cal. The Company will make Redlands its headquarters. This enterprise will involve an expenditure of about $750,000 in material, labor, etc. The Company, it is stated, has secured all the necessary legal titles and land, and will be able to deliver power to Los Angeles by the first of January, 1898. The line will run through San Bernardino, Pomona, Ontario and Pasadena.

The Electric Railway.

AUGUSTA, GA.—The North Augusta Land Company proposes to build an electric railway.

PORTVILLE, N. Y.—The Olean Electric Street Railway will soon be extended to Portville.

BUTLER, PA.—It is likely that a new railroad will soon be built between Butler and Stoneboro.

WATERBURY, VT.—It has been rumored that an electric railroad will be in operation between Waterbury and Stowe before next Fall.

CATSKILL, N. Y.—Louis E. Roberts has applied for permission to build an electric railway in the Catskills, from Catskill Landing to Jefferson Heights.

NEW HAVEN, CONN.—The State Legislature has killed a bill giving to any electric railroad company the right to go into the electric lighting business.

TITUSVILLE, PA.—The City Council has passed an ordinance granting the new Titusville Electric Traction Company a franchise for a street railway here.

GROTON, CONN.—Bids have been made for the extension of the Norwich & Worcester Railroad, from Allyn's Point to Groton and New London.

SALISBURY, MASS.—The H., M. & A. road has asked the Selectmen of Salisbury for permission to lay rails, set poles and run electric cars through the town to the New Hampshire line.

ANDOVER, MASS.—The Selectmen have granted a franchise to the Lawrence & Reading Street Railway Company, which will construct tracks on Main Street from Andover to North Reading.

BADEN, PA.—A charter has been granted at the State Department to the Baden Electric Railway Company to build a line from a point on the road from the City of Allegheny to Baden, Beaver County.

NEWTON, MASS.—The Watertown Selectmen met and granted a franchise to the Newton Street Railway Company to lay tracks and operate cars by electricity on Pleasant and Bridge Streets.

McKEESPORT, PA.—The Homestead & Highland Street Railway Company is preparing to complete its connections between McKeesport and Pittsburg, the object being to secure a through line to the heart of Pittsburg.

OTTAWA, CAN.—The contract for the electrical equipment of the Montreal Park & Island Railway Company's suburban lines has been awarded to Ahearn & Soper, Ottawa, Canada. Westinghouse No. 38-B and No. 12 A motors will be used throughout.

ROCKLAND, MASS.—The directors of the Hanover Street Railway Company have petitioned the Selectmen of Norwell for a franchise granting them the right to lay tracks and operate a street railway on Pond Street in Norwell.

MORRISTOWN, N. J.—James F. Pidock, Morristown, N. J., proprietor and manager of the Rockaway Valley Railroad, which connects the Central Railroad of New Jersey at Whitehall with the Delaware, Lackawanna & Western Railroad at Morristown, is negotiating with Mayor E. Quayle concerning a scheme for the connection of the two roads at Morristown.

McKEESPORT, PA.—The recent flood did considerable damage to electrical property hereabouts. A trestle bridge on Third Avenue, over which electric cars run, was carried away, and passengers had to be transferred by boats in order to reach Reynoldton and Dravosburg. Electric roads running in other directions were also sufferers to a greater or less extent, and the steam roads sustained a very large amount of damage to their lines.

NEW YORK, N. Y.—The application of the Catskill Electric Railway Company for permission to build a line from the water front at Catskill-on-the-Hudson to the Grant House, in Jefferson County, was heard by the Railroad Commissioners a few days ago. The Commissioners also considered the application of the Auburn & Western Railroad Company for permission to build an electric road between Auburn and Seneca Falls, a distance of ten and one-half miles. The hearing was adjourned to a future meeting.

Trade and Industrial Notes.

THE STEWART ELECTRIC COMPANY, Cincinnati, has just issued a little pamphlet entitled "Bargain Bulletin and Repair Price List." The Stewart Company has the general agency for the Eddy apparatus, and, in addition, conducts a large repair shop and deals in second-hand machinery.

THE ELECTRICAL MERCANTILE AGENCY, 318 Broadway, New York, has just issued a neat little pamphlet describing its system of compiling and distributing correct commercial reports on concerns engaged in the electrical trades. Every electrical house should look into the merits of this system.

THE NEW CORCORAN ART GALLERY, in Washington, D. C., was opened to the public on the evening of Feb. 22. The beauty of the exhibit of pictures, etc., and the comfort and enjoyment of the visitors were greatly enhanced by the reflector lighting system installed throughout the building by I. P. Frink, New York City.

FOOTE, PIERSON & CO., 82 & 84 Fulton Street, New York, report an excellent business in their line. They have increased their working force and are busy filling large orders for telegraph apparatus from the Western Union Telegraph Company and the Postal Telegraph-Cable Company.

THE LAKON COMPANY, Elkhart, Ind., has recently received several large orders for transformers for export, and anticipate a large business during the coming season. During the year it installed a complete electric plant of its own, and these facilities combined with the fact that it is manufacturing its transformers under some very good patents, and has the best electrical and mechanical talent at its disposal, places the Company in a position to produce a transformer entirely worthy of the patronage it is receiving.

IMPROVED MICA INSULATING JOINT.—Messrs. Stanley G. Flagg & Co., North Nineteenth Street, Philadelphia Avenue and Hamilton Street, Philadelphia, Pa., have issued a circular describing and illustrating their improved mica insulating joints, which are claimed to be superior to anything of this character now on the market. These joints have been approved by the National Board of Fire Underwriters. They possess some features of considerable merit which those interested will do well to investigate.

THE ELECTROSE MANUFACTURING COMPANY, 127-137 No. Tenth Street, Brooklyn, N. Y., reports that it has succeeded in perfecting, and is now placing upon the market a material far superior to any composition ever offered to the electrical trades as a substitute for hard rubber. The new material has a tensile strength nearly equal to that of hard rubber, is odorless, susceptible of a high finish, and is about 35 per cent. cheaper than hard rubber. This company was awarded the only gold medal at the World's Columbian Exposition that was granted to manufacturers of composition goods.

BRYANT CATALOGUE SUPPLEMENT.—The Electric Appliance Company, Chicago, has just prepared a supplement to the Bryant catalogue of electrical specialties, showing a line of the best electric light specialties that have been brought out during the past year. The supplement is also supplied with a special trade discount sheet giving trade prices on the goods listed. The Bryant specialties have a great reputation, and anything new brought out by this Company is always received with considerable interest. The Electric Appliance Company will be glad to send a copy of these catalogues with discount sheet to any one in the trade on application.

THE BERLIN IRON BRIDGE COMPANY.—The business of the Berlin Iron Bridge Company, East Berlin, Conn., has increased to such an extent that Mr. Charles M. Jarvis, who has been chief engineer of the company since its organization, has been obliged to resign to others the engineering department, and give his entire time and attention to the business management of the corporation. The directors have, therefore, appointed to the position of chief engineer, Mr. James H. Edwards, a graduate of Cornell University, who has been connected with the Bridge Company a number of years as Mr. Jarvis' chief assistant. Mr. Edwards is, by education and experience, well qualified for the new and important position to which he has been elected.

WATER WHEEL GOVERNORS FOR THE MINNEAPOLIS PLANT.—The Lombard Water Wheel Governor Company, Boston, Mass., has closed a contract with the St. Anthony Falls Water Power Company, Minneapolis, Minn., to furnish seven governors for the new plant which the latter Company is now building. These seven governors are to regulate four water wheels each, or twenty-eight water wheels in all, aggregating 10,000 horse-power. The style of governor to be employed in this plant is designated by the manufacturers as Type C. During the past year the Lombard Company has with this type of governor regulated over 40,000 horse-power of water wheels in the United States. On account of the magnitude of the Minneapolis plant the question of governors was very carefully looked into before the above order was placed.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY.—This well-known concern, which is one of the most prominent establishments in Utica, N. Y., is preparing to build a new and much larger plant. These improvements are rendered necessary on account of the large and growing business with which the Bossert Electric Construction Company is favored. The company's wall and outlet switch boxes and steel-clad slate-lined panel and conjunction boxes and switchboards are among the standard goods on the market, and are growing in favor constantly. The company's new building will cover an area of 48x88 feet, and will be two stories high, with provision for adding a third story when occasion requires. Everything that will enter into the construction of the building and its equipment will be most modern, and when the improvements are completed the company will be in a position to largely increase its output.

A PROSPEROUS CONCERN.—The Board of Directors of The Davis & Egan Machine Tool Company, Cincinnati, held its annual meeting Feb. 20 and elected the following named officers for the ensuing year: Chas. Davis, president; W. H. Burtner, vice-president and treasurer; B. B. Quillan, secretary. The Board declared a dividend of 3 per cent. out of the earnings of the past three months. The Company reports having done a very heavy foreign business during the past six months, and to have added to its shop equipment some $34,000 worth of machinery. It has made many important alterations in its buildings, and is now erecting a large warehouse at the corner of Sixth, Eggleston Avenue and Lock Streets, in which to store all surplus tools as soon as a lot is finished, which will give the Company hundreds of square feet of floor space in its regular shops for manufacturing purposes, heretofore used as storage.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York, sole agents for the A. E. G. incandescent lamp, report large orders for the same, and that business has a very satisfactory outlook.

MR. H. J. GORKE, 240 West Fayette Street, Syracuse, N. Y., is already selling several good lines of supplies. Mr. Gorke recently opened a business of his own at the above address, and is handling motors, dynamos and a general line of electrical supplies.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., is fitting up a factory at the corner of East Water and Grape Streets, in that city, where it will soon be ready to turn out the well-known Hinds knife-switches, panel boards, junction boxes, switchboards, etc.

THE STANDARD TELEPHONE & ELECTRIC COMPANY, Madison, Wis., reports an increased activity in its business and growing popularity of its product. This Company has recently closed a very fine contract in the East which will cover the installation of about fifteen hundred telephones when complete.

THE BALL & WOOD COMPANY, 120 Liberty Street, New York, has just started the 450-hp cross compound engine recently installed in the Morris County Electric Company's plant at Morristown, N. J., making the third Ball & Wood engine furnished this station. This company is also shipping, this week, two of its 150-hp engines to the Mutual Light & Power Company, Knoxville, Tenn.

BALL ENGINE COMPANY.—The Paul O. Stensland Building, at Chicago, has increased its electric plant by the addition of a direct-connected engine and dynamo, the engine being furnished by the Ball Engine Company, Erie, Pa., and the dynamo by the Jenney Electric Company, Indianapolis, Ind. This is the third direct-connected outfit furnished by the same companies in this building.

THE PHOENIX INTERIOR TELEPHONE COMPANY recently moved into its new quarters at No. 93 Washington Street. The entire building, five stories high, is occupied by the Phoenix Company, and devoted exclusively to the manufacture of telephones and switchboards. Mr. Sutton, the president, states that business with his company is in an excellent condition, and that it is necessary to keep the factory going night and day to avoid falling behind in filling orders.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., has just secured the order for the entire engine equipment of the new station of the Scranton Illuminating, Heat & Power Company, Scranton, Pa., which is to be built on the site of the old one recently destroyed by fire. The equipment will consist of six American-Ball engines, five of which will be compound and one simple. Direct-connected generators will be used on four of these engines, and the station will be modern in all its appointments.

THE TENNESSEE EXPOSITION.—Among the exhibitors so far scheduled to participate in the Tennessee Centennial Exposition, which will be held in Nashville this Summer, are the following: The Western Union Telegraph Company, Nashville, Tenn.; William Wharton, Jr., & Co., Philadelphia, Pa.; Gleason & Bailey Manufacturing Company, New York City; The Carborundum Company, Niagara Falls, N. Y.; the Edward P. Allis Company, Milwaukee, Wis.; James Leffel & Co., Springfield, O.; The Southern Belting Company, Atlanta, Ga., and the National Tube Works Company, McKeesport, Pa.

BRILLIANTLY LIGHTED WINDOWS in a store attract customers, and to accomplish this lighting the Frink Special Window Reflectors were put upon the market. Large sales are reported from the various places where these window reflectors have been introduced. Messrs. William Browe & Son, the well-known electrical engineers and contractors, Newark, N. J., recently installed the Frink reflectors in the windows of one of the largest department stores in that city, to the great delight of the proprietors. In fact, this installation has proven so satisfactory that another store in a neighboring city at once adopted the same system of window lighting, after noticing the brilliant effect secured in the Newark store.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing the March celluloid calendar for its souvenir transformer ink-wells. The Wagner apparatus continues to grow in the estimation of central station operators. It is guaranteed to have the highest efficiency possible consistent with commercial practice. The Wagner Company makes very liberal propositions to replace old switchboards and transformers with its improved devices. The loss of energy in many cases between the points of generation and consumption has been found to be as high as 50 per cent., causing, in a large measure, the failure of lighting plants to pay dividends. The Wagner Company claims that these losses can be avoided by the use of its apparatus.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has been given the Western agency for the full line of adjustable incandescent lamp holders made by the O. C. White Company, Worcester, Mass. These holders are specially adapted for factory, mill and machine-shop work, where the operator must have good light. They are simple in construction, strong and durable, and do their work perfectly; are made in various forms, to suit all classes of work. They allow the lamp to be shifted instantly, by the simple movement of one hand, to any desired position. A few of the many who are using these holders are: R. Hoe & Co., New York City; Washburn & Moen Manufacturing Company, Westinghouse Machine Company, Wagner Palace Car Company, etc., etc. The Metropolitan Company recommends these holders to be what is claimed for them.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., will hereafter manufacture the Thompson-Ryan dynamo and the McEwen engine. On Feb. 22 the Ridgway Dynamo & Engine Company, which is composed of a number of the most prominent business men in the western part of Pennsylvania, purchased the property of the J. H. McEwen Manufacturing Company. The factories are now being thoroughly overhauled, and the new company is getting ready for active business. Mr. Cyrus Robinson will be general manager of the Ridgway Dynamo & Engine Company, as he was of the J. H. McEwen Manufacturing Company. **Both the dynamo and the engines have always borne an excellent reputation in the trade, and as it is the intention of the reorganized company to push the business vigorously, there can be no question as to the success of the concern under the efficient and experienced management of Mr. Robinson.**

McCORMICK TURBINES FOR NIAGARA FALLS.—The S. Morgan Smith Company, York, Pa., has just been awarded the contract by the Niagara Falls Power Company, Niagara Falls, N. Y., to furnish four vertical McCormick turbines in iron cases, together with all the necessary inlet piping, shafting, etc., required in connection with the same. These turbines will operate under about 140 feet head. The S. Morgan Smith Company is naturally highly elated over this order, which speaks well for the McCormick turbines as well as for the manufacturers. The Company has also received word that the pair of 60-inch McCormick turbines furnished to the Montreal Cotton Company, Valley Field, Quebec, which are operating a 600-hp generator, and are direct-connected to a jack-shaft, the power of which is transmitted through gears, have been working successfully for six months. This is particularly noteworthy for the reason that comparatively few generators are driven by vertical wheels, the power of which is transmitted through gears. The Montreal Cotton Company has given the S. Morgan Smith Company orders to duplicate this outfit.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 23, 1897.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

577,427. ALTERNATING CURRENT MOTOR; L. Gutmann, Pittsburg, Penn. App. filed Feb. 4, 1891. An alternating current motor, consisting of the combination of a field-magnet core, one or more windings for the same, an armature core, a winding or windings for said armature-core, contact-terminals connected to said winding or windings, and a block or brush permanently in contact with one armature terminal and temporarily with the other or others.

577,447. AUTOMATIC CIRCUIT BREAKER; G. F. Packard, Fort Wayne, Ind. App. filed Sept. 22, 1896. The combination in an automatic circuit-breaker of metallic contacts for closing the main circuit between the terminals, high resistance contacts for closing the shunt-circuit between the terminals; a pivoted hand-lever carrying the bridging-contact for the main circuit; an arc rupturing plate pivotally mounted on said hand-lever and adapted to be automatically thrust or interposed across the path of the arc, an armature to which is attached a weight or spring to resist the magnet pull of the armature, and having a catch or trigger adapted to holdingly engage the said hand-lever when the working circuit is closed; and an electro-magnet.

577,450. ELECTRIC RAILWAY SYSTEM; C. F. De Redon, New York, N. Y. App. filed Sept. 5, 1895. In an electric railway system, a circuit closer, comprising a permanent magnet adapted to be attracted by a part carried by a car, a lever on which the magnet is placed, a contact plate carried by said lever and contact blocks to be engaged by said plate and having connection with the current carrying wires.

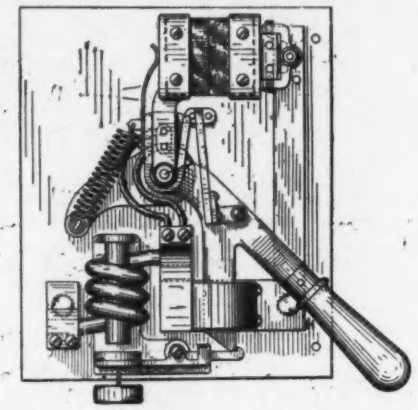
577,480. ELECTRIC TRANSFORMER; L. Gutmann, Peoria, Ill. App. filed April 25, 1896. In an electric iron-clad transformer the combination of the laminated iron envelope, having its laminae made each of three punchings of magnetic material, two of them fitting together from opposite sides of the coils, and a centre plate entering within the coils and interlocking with the two punchings first named at points out of coincidence and with successive laminae reversed.

577,499. FILAMENT FOR ELECTRIC LAMPS; J. H. Douglas-Willan & F. E. W. Bowen, London, England. App. filed Aug. 3, 1896. The process of treating filaments and rendering them incandescent in the presence of a compound containing boron, carbon and oxygen.

577,526. ELECTROPNEUMATIC BRAKE; F. Chapsal, Paris, France. App. filed Sept. 24, 1896. In electropneumatic brakes, the combination with an auxiliary reservoir, distributor, brake-cylinder, and an electric brake-valve and an electric release valve of electro-mag-

netic means operating one of said valves when moved in one direction and the other of said valves when moved in the other direction, an electric circuit for energizing said means and a commutator for reversing the current on said circuit.

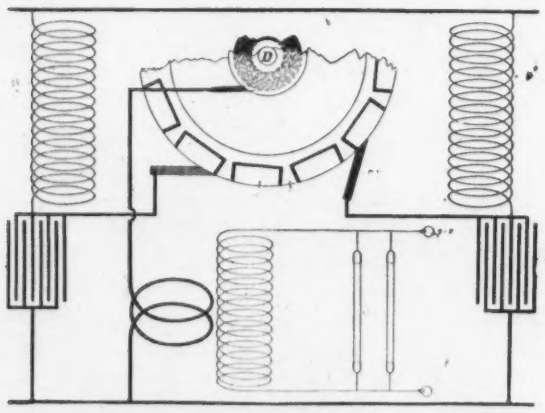
577,532. ANNUNCIATOR; A. R. Miranda, Boston, Mass. App. filed Nov. 17, 1896. In an annunciator for hair-dressing establishments, a case suitably provided with a front wall, hooks extending from said case, checks suspended on said hooks; rods extending from said case, and each rod extending above a corresponding check-hook out of contact therewith, but with its forward portion sufficiently near the corresponding portion of the hook to cause the check during the process of removal to come into contact with said rod and thus electrically connect the same with the hook next beneath it; an annunciator; and electrical connections, said annunciator, hooks and rods being in electric circuit.



No. 577,447.—Automatic Circuit-Breaker.

577,534. SUBMARINE TELEGRAPHY; A. Muirhead, London, England. App. filed Nov. 18, 1895. In an automatic telegraph-transmitter the combination with the perforated-ribbon actuating device and the lever contact devices adapted to respectively enter perforations in the traveling ribbon and by their movement thus adapted to establish battery-contacts, of a rotating cam acting after a determined interval of time to restore the contact-lever devices to their normal position.

577,540. TELEGRAPH TRANSMITTER; H. A. Taylor, London, England. App. filed Nov. 18, 1895. In an automatic telegraph transmitter, the combination with contact-levers, a punched paper tape and needle-levers, of cams adjustable relative to each other, located on an arbor of the driving mechanism of the instrument, and intermediate levers each operated by one of said cams, one cam with its operated intermediate levers serving, in conjunction with the punched paper tape, to control the movements of the contact-levers in one direction, and another cam with its operated intermediate levers serving to return or reset the contact-levers to their normal positions after a regulated interval of time.



No. 577,670.—Apparatus for Producing Electric Currents of High Frequency.

577,635. ELECTRIC BELL FOR HIGHWAY CROSSINGS; W. W. Alexander & M. C. Gillham, Kansas City, Mo. App. filed March 23, 1896. The combination of a railway-track having an electrically-continuous rail and a rail comprising sections insulated from each other, an electromagnet, its armature adapted to vibrate between two contact points, battery connections between the intermediate rail section and the continuous rail, and including the magnet and said contacts, and electrical connections between the armature and the other rail-sections.

577,644. ELECTRIC ELEVATOR; J. P. Casey, Philadelphia, Pa. App. filed June 13, 1893. In an electric elevator the combination of a winding drum, a power device to rotate the drum, a lifting cable, a movable part adapted to control the power device, a pawl carried by the movable part, a rotating tooth or ratchet wheel moved by the winding-drum or the power device, a movable frame provided with a guide adapted to press against the lifting cable and furnished with a shoe to forcibly press the pawl into contact with the ratchet wheel, whereby in case the cable becomes slack the shoe and movable frame shall operate the pawl to throw it positively into engagement with the moving toothed or ratchet wheel, and thereby move the movable part to stop the operation of the power device.

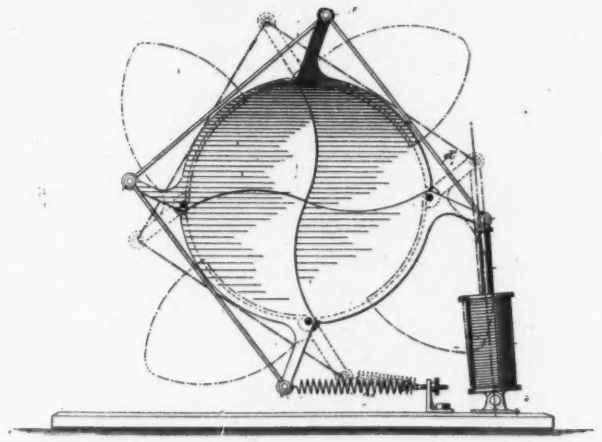
577,670. APPARATUS FOR PRODUCING ELECTRIC CURRENTS OF HIGH FREQUENCY; N. Tesla, New York, N. Y. App. filed Sept. 3, 1896. The combination with a source of electrical energy of a plurality of condensers and a discharge-circuit therefor, a moving device and a circuit controller operated thereby and adapted to direct the energy of the source into the condensers and connect them with the discharge circuit successively and in alternation.

577,671. MANUFACTURE OF ELECTRICAL CONDENSERS, COILS, etc.; N. Tesla, New York, N. Y. App. filed Nov. 5, 1896. The improvement in the manufacture of electrical devices such as condensers, which consists in enclosing the device in an airtight receptacle, exhausting the air from the receptacle, introducing into a vessel containing the device an insulating material rendered fluid by heat, and then, when said material has permeated the interstices of the said device, subject the whole to pressure and maintaining such pressure until the material has cooled and solidified.

577,678. VOLTMETER; P. Brandt, Berlin, Germany. App. filed Aug. 6, 1896. A core or armature for solenoids, comprising a soft iron sleeve and a bundle or cluster of wires contained therein.

577,707. ELECTRICAL INSULATOR; T. W. Young, Washington, D. C. App. filed Sept. 23, 1896. A conductor of electricity in combination with an electric heater, arranged in proximity to a support of the conductor and a hood for shedding water away from the electric heater.

577,730. TOY; L. A. Eberhardt, New York, N. Y. App. filed July 9, 1896. A toy composed of a base plate, a superposed horse-shoe magnet and a metallic object adapted to be moved along the base plate and between the magnet shanks.



No. 577,816.—Device for Controlling Light Effects.

577,741. TROLLEY FOR ELECTRIC RAILWAYS; H. N. Gale, Bristol, Conn. App. filed Oct. 16, 1896. In combination, the trolley pole, the forks borne by the trolley pole, having ways for the trolley wheel shaft, the trolley wheel shaft hung in said ways and the trolley wheel rotarily hung on said shaft.

577,742. ELECTRIC TRANSFORMER; L. Gutmann, Peoria, Ill. App. filed April 25, 1896. In a magnetic core for electric transformers the combination of two U-shaped plates, adapted to interlock with one another in such a manner as to be inseparable in any direction other than vertical to the plane of the plates.

577,760. ELECTRIC ARC LAMP; G. M. Lane, Asbury Park, N. J. App. filed Jan. 4, 1896. In an arc lamp the combination with high and low resistance magnets, an auxiliary magnet, carbons and feeding mechanism, an armature carrying a pin and the armature of the auxiliary magnet connected with a contact plate.

577,771. SECONDARY BATTERY; H. G. Morris, Philadelphia, Pa. App. filed Sept. 5, 1895. The combination in a secondary battery of a cell having supports therein below the liquor level, a battery plate, consisting of two or more sections connected together by necks, the upper section being in the form of a beam, from which the other section or sections are suspended, said beam section being part of the active plate within the liquor and resting upon the supports within the cell.

577,816. DEVICE FOR CONTROLLING LIGHT EFFECTS; H. V. Arnold, New York, N. Y. App. filed Feb. 24, 1896. A theatrical display apparatus, comprising projector having a reflector, means for swinging the projector in altitude and azimuth, and a plurality of movable screens for modifying the beam of light carried by and moving with the swinging projector and electromagnets moved with the projector, and connected to the said screens for operating the same independently of each other.

577,822. ELECTRIC CUTOUT; J. F. McElroy, Albany, N. Y. App. filed Oct. 20, 1894. In an electric cutout the combination of a porcelain block a curved grooved channel-way, therein a curved fuse-wire placed in said channel-way suitably connected with a flexible covering over said channel.